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Engineering News-Record

Devoted to Civil Engineering and Contracting
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"Another Average Engineer" Issue

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Articles for the
"AVERAGE ENGINEER"

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By H. L. Thackwell

Good and Bad Practice in Making Bituminous Patches
By John S. Crandell

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By S. H. Wright

Flood-Proof Bridges for Andes Streams
By Donald G. Coombs

Simple Solutions of Three Highway Construction Problems
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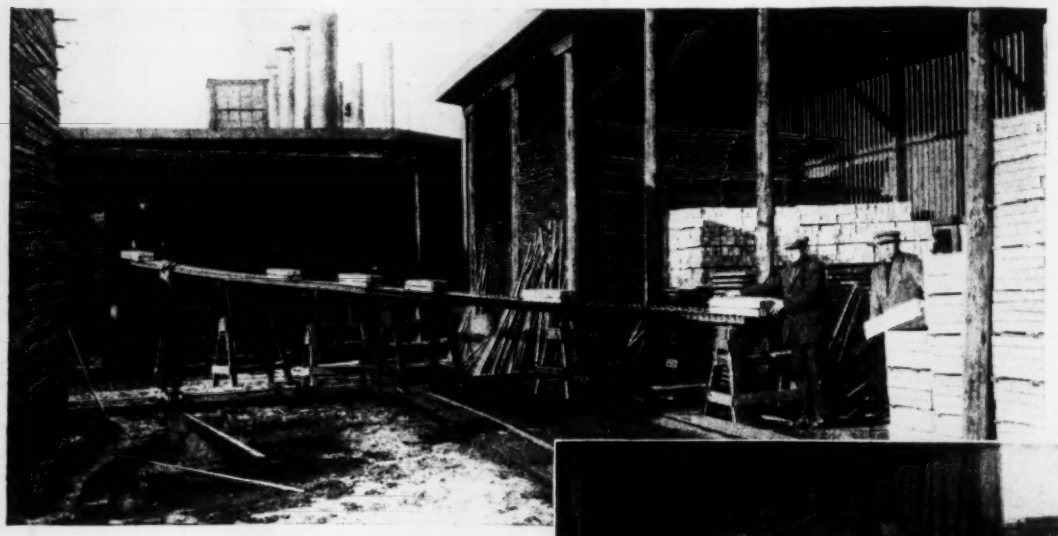

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

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Co-ordinated National Transport

NEED FOR more effective co-ordination of the national transportation system to bring the various means of carriage into their greatest usefulness was strikingly brought out in the addresses last week at the transportation session of the American Society of Mechanical Engineers' annual meeting. The program was remarkable for agreement in this fundamental need, so difficult of accomplishment, and the papers presented were of such high quality as to warrant unqualified commendation of the society's enterprise in arranging for them. Abstracts of some of the papers appear elsewhere in this issue, but for lack of space those of the other two will not appear until next week. They are deserving of a thoughtful reading.

Highway "Service"

COMMON sense in highway engineering is epitomized in the article on page 1187 by A. R. Hirst, state highway engineer of Wisconsin. A highway department, it is contended, exists to give transportation service. This is accomplished by building a large mileage of permanent grade, temporarily surfaced, and not a limited mileage of main route brought to high standard by paving. It keeps in mind that improvement is subordinate always to the carrying of traffic. These are the fundamental ideas in an article filled with thought-provoking statements. They represent the trend of practice in the Mississippi Valley states, where great mileages of trunk-line road remain to be permanently graded and provided with drainage structures. "Transportation service," in a phrase, is the highway doctrine of the Middle West. The fact deserves emphasis because it represents a change from the earlier hard-pavement doctrine borrowed from practice in the East where, to a large extent, there remained in the way of improvements only the perfection of permanent grade by hard surfacing.

Service and Road Widths

GRAVEL roads are given high rank by Mr. Hirst as economic highways. Here again he voices a growing conviction of highway engineers in the Middle West. Particularly does he voice the germinating thought that the economic service of a gravel road is greater or less in almost direct proportion to its width. Specifically, if a gravel roadway 16 ft. wide has a serviceable life of three or five years, then 10 ft. added to this width will increase its serviceable life to six or ten years. These figures are not definite; they merely express the comparison which it is sought to emphasize. Moreover this comparison does not hold true, nor is any broad assertion of the worth of gravel roads quite true unless there is continuous maintenance. Wherever gravel roads are giving notable service good maintenance is as much the reason as is good construction.

Unsightly Concrete Surfaces

IN ordinary commercial concrete construction is there any prospect of being able to make exposed surfaces of permanently good appearance without finishing treatment? Considerable economy should result from a successful answer to the question, since it would make possible a large reduction of the use of brick and tile facings now used solely to conceal unsightly concrete surfaces. It would also make it possible to avoid the distressing appearance of concrete structures on which such veneering has been omitted for reasons of economy. On bridges and important structures the exposed surfaces are often given special finishing treatment by washing, grouting and rubbing in order to secure a satisfactory appearance, but the effect thus obtained is sometimes of short life, being soon marred by the characteristic patches and streaks of discoloration. Painting is seldom employed and rarely successful. Cracks in the concrete have not been considered in the foregoing remarks, but in spite of reinforcement there is a frequent occurrence of such defects, which may be of little or no structural significance but are seriously detrimental to the appearance. There is an open field for developing concrete construction that can honestly show its own face without causing pain because of its unsightliness.

Articles for the "Average Engineer"

FOLLOWING the precedent set in the July 22 number of this journal, another "Average Engineer Issue" is herewith presented. Its aim is to give to engineers and contractors engaged in the non-spectacular but important work of the small organization details of field and office practice which will be helpful to them. The term "average engineer" is employed only for want of something better and is not susceptible of any precise definition. He may be the city engineer of some small town, chief of party on a topographical survey, a waterworks superintendent, a county highway engineer, a designer on a structural engineer's staff or a construction superintendent. He may be "going it alone" or be the non-commissioned officer intermediary between the commanding officer—a chief engineer or contractor—and the rank and file on the job or in the office. The interests of the readers of the *Engineering News-Record* are extremely varied. This fact the editors realize and the effort is made to balance the material in each issue, apportioning space to articles on the large as well as on the small project. After the appearance of the first "average engineer" issue last summer, however, letters were received from so many readers endorsing the idea that it was decided to repeat the experiment. The range of articles this week is wide, covering such topics as useful "dodges" in surveying, good and bad practice in making bituminous patches in highways, the checking of drawings, estimating small sewer jobs and the use of

special slide rules in valuation work. It is hoped that from the dozen articles presented this week the "average engineer" will secure information or suggestions of practical use in the day's work.

Our National Parks

THE rapid increase in the use of our National Parks is gratifying. The increase is partly due to the commendable work done by the National Park Service to make the park facilities known. A recent instance of such publicity is a press bulletin outlining the extent to which a number of the National Parks can be readily used and enjoyed in winter—some for distinctly winter sports. The National Parks have a special appeal to outdoor men like engineers; and many engineers, in their travels about the country, have or could readily make opportunities to visit them. Comparatively few people know what national parks exist and how to reach them. Information can be had from the National Park Service for the asking, besides which there are now some four or five books giving handsomely illustrated descriptions of our national parks and monuments.

Gravel Roads

HIGHWAY administration in Maine includes at least two practices which may well be studied by states whose programs do not call for extensive construction of high-type pavements, but whose highway systems demand general improvement. These two practices, fully discussed on page 1177, concern the construction of plain gravel highways and the maintenance of surface-treated gravel. Specifications to be found in most highway handbooks and, in fact, adopted by various state highway departments, which call for the bonding with clay of the top course of plain gravel roads, have been replaced in Maine by those that require the top course to be of the cleanest gravel. Instead of rolling, consolidation of the surface is skillfully avoided. In fact, a loose, or "live," surface course is deemed necessary for success. In surface treatment the economic distribution of bitumen has become an art. "Put the bituminous material only where it is needed" is an old maxim in Maine's maintenance.

Need for Engineering Publicity

INNUENDO and quoted surmises in regard to the works of the engineer may cause a distrust that is entirely unwarranted. One of the latest attacks of this kind is upon the water supply of Duluth. Several newspaper editorials seem calculated to lead water consumers to assume an attitude of suspicion toward it. There is a job waiting for the publicity committee of the local engineering society. The facts, as the *Engineering News-Record* learns them, indicate that the city is blessed with a zero-turbidity water and one which by daily analysis seldom has a bacterial count in excess of 25 per cc. But since slight pollution from the nearest sewer, four miles from the intake, might occasionally be expected chlorine has been used for eight years. *B. coli* are seldom found in the pump discharge but they do occur more or less frequently in samples taken from the city taps. These bacteria may possibly come from surface contamination of one of a number of open-topped reservoirs on the hillsides. The creation of a nuisance in the Duluth-Superior harbor by sewage in the future is quite another question and should stand as a sanitary problem by itself. Simple protection of the surface reservoirs would seem to be about all that is necessary to give Duluth an ideal supply. There being much to be said for and little against the purity of the city water, the local engineering society should be the first to assure the citizens, through the layman's medium, the newspaper, of the good quality of the water supply.

Bettering Sanitary Conditions

MORE cities should enact *and enforce* ordinances like the one recently passed by Raleigh, N. C., requiring all buildings in which one or more persons live or work to be connected with the local water-works and sewerage systems. Sewer connections have been at least nominally required in a considerable number of cities for many years but there are still hundreds of communities that either lack such rules or fail to enforce them. The Raleigh ordinance prohibits owners and agents from leasing any property not provided with water and sewer connections, and empowers the local court to order the refund of rentals paid where the owners have been convicted of non-compliance with the rules. This and other clauses make the Raleigh ordinance noteworthy. Moreover, there is evidence that the local authorities intend to enforce the ordinance—all of which gives promise of improved health and sanitary conditions at Raleigh.

Why This Feeling?

REPRESENTATIVES of the thirty-five third-class cities of Pennsylvania, with delegations from all the larger cities of the state, if securable, are to march a thousand strong to the State Capitol when the legislature meets in January and demand the repeal of the Public Service Commission law. In the adjoining State of New Jersey the Governor, responding to a similar popular feeling, removed the Public Utility Commission a few weeks ago. In other states there is equally strong feeling against public service commissions, although not always so well organized and so forcibly expressed. Why is this? The fundamental cause lies in the popular conception that the purpose of these commissions is to reduce rates and that to increase them is proof that a commission is false to its trust. War and after-war conditions have resulted in a large number of cases of increased utility rates. This the public, suffering from high prices on every hand and with a confident belief that there is profiteering everywhere, deeply resents. Hence the demand that utility commissions be removed, as in New Jersey, or abolished, as in Pennsylvania. The utility companies feel that the public is unreasonable, to put it mildly, but they should remember that the public service commissions never would have been created if the patrons of the utilities had not believed—too often with good reason—that otherwise good service and fair rates could not be obtained without almost unending litigation and court delay. Consequently, when these commissions were created the people expected them to lower rates, not raise them. What the public needs to learn is that the function of utility commissions is to see that even-handed justice is done to the companies as well as to the consumers. To convince the public of this, especially in these times of high prices, will be a hard, slow task, demanding judicial qualities of the highest order on the part of the commissions and their engineers, and a change of attitude, both before the commissions and towards their customers, on the part of the utilities.

A Fair and Full Trial for the Motor Truck in Terminal Service

EVEN UNDER this year's congestion at railroad freight terminals line-haul freight did eventually get through; the terminals, therefore, from that standpoint, are in general adequate for present tonnage. The complaint comes because the terminals, as the neck of the transportation bottle, cut down the rate of traffic flow demanded by industry. In fact the rate has been cut below present line-haul capacity—resulting in loss of revenue to the carriers themselves. Every year 100,000,000 tons of package or less-than-carload freight must pass through these terminals attended with congestion and delay and absorbing an inordinate share of the railroads' gross revenue. It appears that the terminals themselves are not bad, but that the fault lies in their operation. In Cincinnati there has been developed a system of l.c.l. interchange employing motor trucks with demountable bodies that has resulted in striking economies and speed of operation. With this demonstration of two years of successful service, the motor-truck, tied in effectively with the existing terminal plant, should be given a fair and full trial in increasing traffic capacity, bettering service to shippers, and saving money for the carriers. Engineers have directed their efforts for increasing terminal capacity to tremendously expensive improvements. Is it not their duty as practical economists first to develop to the utmost a method that promises large results with little capital outlay?

As indicated by the operating figures of one railroad entering Cincinnati, about 28 per cent of all l.c.l. freight passing through that terminal area is being handled with fifteen motor-truck chassis, and the indicated 50-per cent decrease in total loss and damage claims on freight so handled alone amounts to more than the railroads are paying for the transfer service. The cost of transfer has been reduced. Freight movement has been advanced 52 hours. Continuous service of 154 trap or ferry cars, 115 heavy horse drays, some 300,000 switch-cut movements annually and a large portion of freight rehandling have been eliminated. Available platform area and station-track capacity have been increased by current movement and freedom from congestion. Doorways previously held for dray service have been released to shippers. If such remarkable economies, carrying capacity and speed of handling, *effected merely by adapting existing facilities to an efficient system of operation at comparatively small capital cost*, have been secured at Cincinnati it is certain that new methods of terminal operation, permitting a higher rate of traffic flow, are needed at most other important terminal points as well. The alternative is large increases of plant, operated by old, slow and wasteful methods.

At present the Cincinnati system is being used only in exclusive railroad service for the interchange of l.c.l. freight between main and substations. It was described and commented upon editorially in the *Engineering News-Record* of March 11, 1920, pages 498 and 508. At the meeting of the Federal Highway Council's committees in New York last week, reported elsewhere in this issue, the extension of the system to even more important uses and its further possibilities were ably presented by Mr. B. F. Fitch, president of The Motor Terminals Company of New York and Cleveland, and chairman of the board of The Cincinnati Motor Terminals Company. The possibilities for extension hold promise of such great advantages that precedents should not stand in the way of a fair and thorough trial. The possibilities are: First, the elimination of the industrial-siding, intra-terminal trap, or ferry, car; second, the operation of zone freight stations without rail connection to permit the development of new industrial districts and to provide centers for store-door delivery; third, line haul of loaded demountable bodies on flat cars without rehandling of freight at stations properly equipped.

Unfortunately there appears to be an immediate obstacle to a trial of such extension. This is the fear of disrupting existing switching tariffs and existing traffic treaties between individual railroads and shippers arising from the connection of manufacturing plants with the rails of one or more carriers. For instance, the Cincinnati motor service can now actually be offered for extension to some manufacturers at much less than present switching tariffs and at one-quarter of the estimated cost to the carrier for industrial intra-terminal trap car service. The reason that the truck service has not already been thus extended is no doubt due to the fear of some of the railroads that traffic now controlled by them for a large share of line-haul tariff might be diverted for line haul over competitive lines. This, in spite of evident economies and better service to shippers, and in spite of the fact that the effect of such a new method of operation would, in the aggregate, if conceded by all railroads in a terminal, be to divert practically as much business to each of the carriers as would be diverted away from them, subject only to the deficiencies and advantages of wastefully competitive transportation. Here is the opportunity for such a body as the Association of Railway Executives to undertake bold initiative in the public good.

Great credit is due Mr. Fitch for his work in the public service and for his exhaustive study of the past five years that led to the adoption of the Cincinnati system which he developed and put into operation. Credit also is due Mr. H. A. Worcester, vice-president of the Big Four, who had the foresight and courage to authorize the original test of the new system.

It is most encouraging to note the increasingly liberal attitude of railroad officers to radically new methods, as instanced by the remarks of Colonel Charles D. Hine and Mr. F. E. Williamson, who represented the American Railway Association at the meeting of the Federal Highway Council transportation committees. Daniel Willard's address last week before the Mechanical Engineers was also significent in this respect, voicing strong sentiment for employing new methods where found economical, with particular emphasis on the motor truck's possibilities. Undoubtedly all of these views were expressed wholly in the interest of better service to the public. However, railroads must realize that private operation and ownership are still on trial and that the public will condemn the managements if they refuse, through the inertia of routine-bound precedent, to investigate thoughtfully the merits of such a system as that at Cincinnati, and to give such a system and also its further applications a fair and full trial. Such a trial should be made regardless of any selfish individual interests.

The railroads should be all the more open-minded on methods of improved terminal operation with present plant, since the capital outlay involved in the only alternative—extensive terminal additions—will run into stupendous figures, a prospect that is forbidding in view of the present financial position of the roads.

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A Few Useful Dodges in Surveying

BY H. L. THACKWELL
Civil Engineer, Anaconda, Mont.

THE theory of surveying has been so thoroughly covered by many able authors that the practising surveyor need not be at a loss to find a book which will aid him in solving any complex problem. All engineers and surveyors of experience, however, have had recourse to simple dodges or methods which, though sometimes inelegant, are helpful in situations that require resourcefulness and ingenuity. Such matters are not printed in books, but are frequently disclosed by men of experience to those under them. The writer, a sometime government surveyor, can vividly recall situations where the ordinary instructions given in textbooks did not help the instrumentman in finding the backsight when the personnel of the party did not include a backflagman, nor in making an observation on the sun for a meridian when he had thoughtlessly left his watch in camp 5 mi. away.

The following dodges are listed for the benefit of those who may find them useful. The writer has used all of them with one exception, that in No. 3. Most of the ideas have come to him independently, although no doubt others have originated them.

1—How to Get Along Without Back-Flagman

In the West a surveyor is frequently called upon to survey a ranch or homestead and, upon arriving on the ground, finds that, although plenty of assistance had been promised for the work, only the client and his small boy present themselves. They would act as rodman and axeman respectively. How to get along without a backflagman is illustrated in Fig. 1.

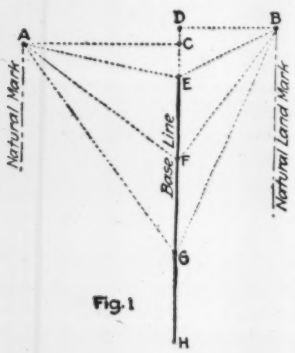


Fig. 1

The point of origin of the survey is at *E* and the survey is to be run in the direction of *EG*. Lay off the base line *EF*. Pick out two conspicuous points in the landscape, *A* and *B*, one on either side of the line to be run, and choose them with respect to their visibility and ease of bisection. Triangulate these points and compute the distances *AC* and *BD*, also *CE* and *DE*. Set up the transit on *E*, foresight on *F*, and set a point *G* on line. Then measure the distance *FG*. In the notebook keep a column or progressive distances from the point of origin *E*. Set up the transit on *G*; since there is no back-flagman recourse can be made to either of the natural monuments *A* and *B*, using that one which happens to be visible. Having the distances *AC* and *DB* and the progressive distances *CG* and *DG* the angle *AGC* and *BGD* can be readily computed.

If the landmark *A* is chosen set the angle *AGC* off on the plates, backsight to *A*, turn the plate in the correct direction so that the vernier reads zero, and the instrument is then in line. Proceed in this manner until the sighting points are invisible or the included angles become too small for accurate use, then triangulate two more points and repeat the process.

2—Laying Off True Meridian with Solar Transit

To lay off a true meridian and to find the time with a solar transit the following method may be used:

Guess at the time as nearly as possible by glancing at the sun. With this inaccurate time calculate the declination and make a solar observation. Read the hour-circle and correct the original declination by the new time. Make another solar observation and read the hour-circle again. If there is any appreciable error between the first and second hour-circle readings repeat the process until there is no further error. The resulting meridian and time will be as close as if the correct time had been used in the first observation.

3—When Day of Month is Forgotten

If the day of the month has been forgotten make an equal altitute observation of the sun and establish a true meridian. Measure the angle from the meridian to the sun, also the sun's altitude. Compute the declination of the sun by the formula

$$\text{Cos. } Q = \frac{\text{sin. dec.}}{\text{cos lat.} \times \text{cos. alt.}} - \text{tan. lat.} \times \text{tan. alt.}$$

The sign of the first term of the right hand side of the equation is minus when the declination is south; the second term is plus where the latitude is south. If the algebraic sign of the result is plus, *Q* is the angle between the sun and the North point, but if it is minus it is the angle between the sun and the South point. Correct the resulting declination by the hourly distance to obtain the declination at Greenwich. If the observation has been made correctly an inspection of the ephemeris will disclose a declination similar to the computed one, and the date corresponding to this declination is the date of the observation.

4—To Avoid High Hill in Line of Survey

In the mountain districts the surveyor is often confronted by a high wooded hill in the line of the survey. In such a situation it is frequently advisable to triangulate to the top of the summit, thus avoiding delay in

clearing the line. To project the line over on to the other side without occupying the summit station go around the hill and triangulate back to the station. Obtain the bearing of the line by solar observation. The original line can then be located by computing the necessary offset from the triangulated station.

5—Tying in Large Objects

When in a topographic survey it is necessary to tie in objects of large diameter, such as smokestacks, monuments, etc., read an angle first to one edge and then to the other. The mean of the two angles will be the angle bisecting the object.

6—Sighting Box for Tunnel Work

In aligning a tunnel under ground a capital sight can be made by using an old powder box, as in Fig. 2. Cut a diamond shaped opening in the box and tack a piece of vellum or tracing cloth over the opening. Take a section of an old level rod about one foot long and nail it across the top of the box. Take a level-rod target and bore a small hole through it near the circumference and on the horizontal line. Slip the target over the rod with the hole downward, then slide in into position over the center of the diamond shaped opening. Hang a plumbline from the hole in the target and place a light inside the box. In the dark the plumbline will show up vividly against the light background. Clamp the target with the set-screw and move the plumbline into the exact alignment by means of the target micrometer-screw. This sight can be used to advantage at night for marking a meridian obtained from a stellar observation.

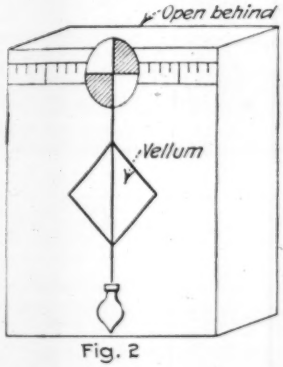


Fig. 2

7—Saving Time by Eliminating Plane Table

In making topographic surveys a great saving in time can be made by doing away with the plane table and using the following method:

The party should consist of an instrumentman, a recorder, and several stadia rodmen. The transitman sets his instrument over a known point and orients it so that the horizontal angles can be taken by azimuth. The recorder, who is provided with a drawing board mounted on an easel, should be seated close to the transitman. The instrumentman reads out the observed angles and stadia distances to the recorder, who immediately plots the points on his drawing board. The plotting is accomplished by the aid of a large semi-circular protractor, which is held in position over the station by a needle stuck through its center into the board. The distances and elevations are computed by a stadia slide rule, and the contours are drawn in in the field before moving on to the next station.

As much as 1,200 acres per day of rolling sagebrush land has been mapped with 5-ft. contours by this method. This system has the advantage in speed over that of the plane-table and the paper can be kept cleaner than would be possible if an alidade were rubbing over its surface. If an accurate angle is required it can be measured directly by the transit plates, whereas the plane-table method would only give approximate angles.

8—Projecting Accurate Lines

When projecting very accurate lines over rough country, such as tunnel alignment surveys, it is of great importance to have as fine fore and backsights as possible. If there are any extra transits at hand, set them up over the points and sight at the plumbline with the aligning transit. The foresight can be set very accurately by this method, even though the observer can not see the head of the tack in the stake.

9—Locating Soundings

In hydrographic surveying of small areas soundings may be taken and their respective locations recorded by the following method:

Construct a suitable raft mounted at one end with sweeps and at the other with a stadia rod set in a vertical position on a swivel and pin so that the rod can revolve in any direction. The raft should have a crew of two men, an oarsman and a soundman. From the shore an observer with a transit should direct the movements of the raft. The oarsman should propel the craft at a more or less uniform rate along lines crossing the lake at definite intervals apart. The soundsman should stand by the stadia rod and sing out the soundings as fast as he can take them, and at the same time keep the stadia rod constantly turned in the direction of the observer. The instrumentman should read magnetic bearings and stadia distances to each of the sounding points and record them with the soundings in his note book. After a little practice he will find it easy to follow the movements of the raft with the transit, and by watching the soundsman anticipate the moment of sounding. In this manner accurate soundings can be taken without interrupting the rowing of the raft. The notes should be plotted, and if any portion of the lake has not been adequately covered by soundings the oarsman can be directed to the spot by the shore observer and soundings taken as needed.

10—Measuring Excavated Prisms

In measuring up the excavated prisms in small canals much time can be saved by making a template, as in Fig. 3. The template should be constructed of light pine strips, the shape being that of the prism cross-section. The center line of the frame should be provided with slots in which can be placed a standard level rod. Readings can be taken on the rod for grade, and by sliding the template down the rod the size and shape of the prism cross-section can be accurately checked.

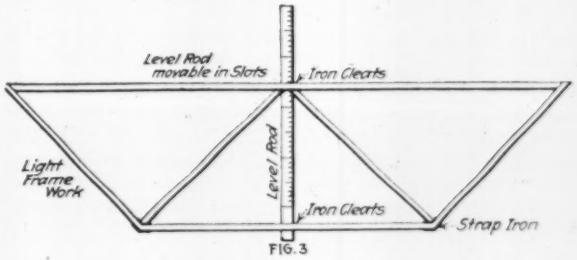


FIG. 3

11—Pipe Line Location on Hillside

In making a location survey for a pipeline along a tortuous hillside it often happens that the distance between two P.I.'s is so short that a reverse curve must

be used. Make both curves of equal radii, so that the pipe will have the least curvature. The following simple formula will solve the curve, Fig. 4:

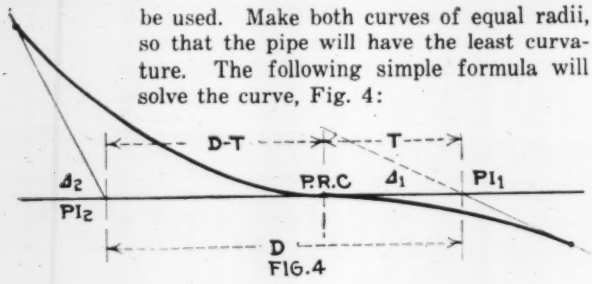


FIG. 4

$$T = \frac{D \cot \frac{1}{2}\Delta_2}{\cot \frac{1}{2}\Delta_1 + \cot \frac{1}{2}\Delta_2} \qquad R = T \cot \frac{1}{2}\Delta_1$$

In locating a flume line around a winding hillside it is economical to build the flume as close to the convex hillside as possible, and in extreme cases even cutting the hillside and building the flume on mudsills. Where the contour is concave build the flume well out so as to give the trestle its maximum height.

The average trestle height should be approximately that which will make the total cost of the line the least. Such a procedure will make the flume of such length that any change in the flume location would increase its total cost. To locate such a line measure the external distance from the P.I.'s of the trial line and by level ascertain the height of the trestle at that point. By reference to previously prepared tables of cost for various trestle heights the economic external distance can be computed.

12—Measuring Head of Water on Weir

It is difficult to measure accurately the head of water over a weir which carries a turbulent flow, such as the discharge from a power house tailrace, or from a fall or chute. In such cases place a raft of logs a few feet above the weir, care being taken to cover practically the whole width of the weir pond. Such a baffle will still the water surface so that accurate measurements can be taken of the head. The use of this method will stop all vibrations in self-recording water-stage registers.

13—Gulch Measurement with Tape

To measure with a 300 or 500-ft. tape a distance across a draw or gulch which is less than the length of the tape:

One chainman should brace himself behind a stake marking the station and hold the zero point of the chain on the tack. The other chainman should pull the tape up with a tape grip until the tension is about 60 lb., then release the tension and pull up again, gradually working a swinging motion into the tape. At the moment when the tape is on the upward swing and there is practically no curve throughout its length the chainman should mark the reading on the tape with his thumb, and, after releasing the tension, read the distance on the chain at the point marked.

14—Reading Stadia in Bushy Country

In reading a stadia rod in a bush-covered country have the rodman hold the rod upside down. Set the top stadia hair on the top of the rod, and set a hand target at the intersection of the lower hair on the rod. The rod interval can be read directly by the transitman, or, if the distance is too great, the rodman can read the hand target, which need be nothing more than the lid of a cigar box painted red or white, with a small cleat nailed along one edge like a T-square.

A Dozen Articles for

Engineer and Contractor—Mutual Use, Not Abuse

By S. H. Wright
Hydraulic Engineer, Philadelphia, Pa.

AT THIS time of year, ordinarily, construction work is at its height, and at the same time many colleges are releasing men, of more or less theoretical perfection, prepared to act as inspectors and engineers and general utility field men on work as varied as the personality of the contractors engaged on it.

In these days of welfare work, industrial relations and production efficiency, too little attention has been given to the relations between contract and money, or their representatives, the contractor and the owner or his agent—the engineer. Of course, human nature never changes but human methods do, fortunately, so that while the contractor and his engineer on any particular job may get along together better than they have, there is reason why a little thought may be given to the subject again with a view to calling to the minds of the new engineers and new and old contractors what each may do so that the owner may pay for what he wants as well as for what he gets; and so that the contractor may have a fair chance to get what he makes, and keep it, instead of losing his catch, as it were, because the engineer or his authorized assistant has backlashed.

The fact is that the system of contract letting is, in itself, bad, and will be abandoned for some plan of cost-plus profit at such a time when the parties concerned have implicit confidence in each other, and are represented in the actual performance of the contract by wholesome, fair-minded men.

It is my endeavor here to point out to the uninitiated and others where some of the pitfalls lie and how they may possibly be avoided, or in other words how two ambitious, responsible, reasoning human beings can perform a good economical piece of work by *using* instead of *abusing* each other. The result is the same whether there are involved in controversy the resident engineer and the superintendent or a foreman and an inspector.

How seldom it is that two average minds can meet in understanding on any given point. To our minds we know exactly what we see, hear and say—yet some other mind equally as intelligent is differently impressed by the same things. Is it any wonder then, that some specifications seem irrational? In competitive bidding the contractor must gamble on his prices, on what the author of the specifications believes he wrote, on the contractor's interpretation of them and on the field engineer's interpretation. The engineer's word shall be final, we say. All right, but I pray you use discretion—judgment.

Here is an honest contractor trying to accomplish a difficult piece of foundation work. He is to clean the exposed rock surfaces preparatory to placing bulk concrete. There are mud, débris and gravel—residue from the excavation—to be cleared up. The contractor starts at 7 o'clock in the morning; by 10 a.m. relations are strained. The rock is not suitable to the engineer as the surface is not properly cleaned—it was thought to

the "Average Engineer"

have been all right but the men were careless, and it is ordered done over again. Rain comes, the hole fills with water and sediment collects several inches deep over the "cleaned" surface. Perhaps two or three days delay follow and the profit on the concrete is gone. Whom shall we blame? Not the contractor, because he says he did not understand the rock was to be holystoned like the deck of a battleship. Not the perhaps too conservative resident engineer who wanted a sandpapered job and couldn't tell just where to draw the line, nor how to get what he wanted.

As a matter of fact this is an important illustration. To prepare such a surface for concrete is a very serious matter and a hard job to perform. It is very necessary that it should be well and thoroughly done. But let us not wait until seven o'clock on the day the contractor expects to concrete to tell him what we want and how we want it done.

A lot of work is done on the "give and take" plan. When the engineer can "ease up a bit" he does so with the idea that, on important parts of the work, he will hold the contractor straight to the letter, a rather questionable practice, depending on the men engaged in the work. Such a compromise often leads to misunderstandings from which the engineer extricates himself with difficulty.

There have been in the courts of Pennsylvania and New York alone cases for adjudication involving millions of dollars based primarily on ambiguous specifications, insufficient field investigations and lack of harmony between the contractor and engineer. Would it not be cheaper in the end to be a little more explicit as to what we really want and expect? It is a known fact that many specifications are drawn purposely lacking in detail because it is feared that too much descriptive matter will either scare the contractors away, or cause them to *bid higher prices.*

The young engineer on his first job or two is apt to be over-zealous. He sometimes feels he may be dealing with a crook and a liar and that only by the most assiduous attention and painstaking effort, which the contractor construes to be harassing and nagging interference, can he fulfill the requirements of his chief and the specifications. The latter he may carry in his pocket to produce on the slightest provocation, and when brought forth with a more or less triumphant flourish, the red flag to the bull is nothing, by comparison. Let the engineer do his studying after or before working hours so that he knows his paper line for line, forwards and backwards, and then when the time comes take a fair, definite stand, being sure of his ground, and let the contractor produce the papers.

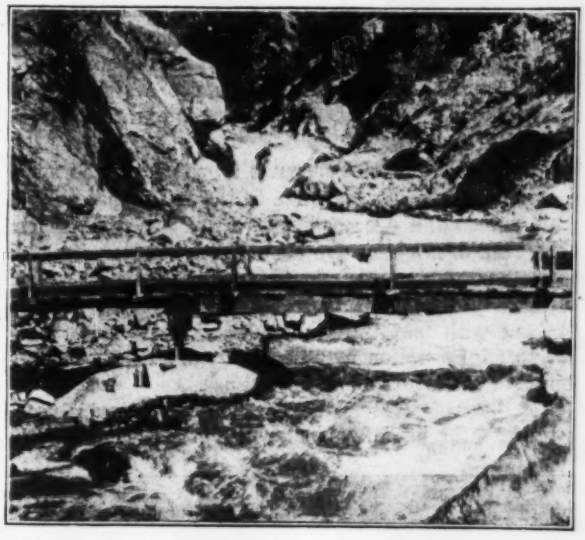
It seems to me therefore, that there is room for improvement in the personal relations between engineers and contractors. It is a great help under trying conditions to put one's self in the other person's position, whereupon the point of view having changed a smooth way out can often be discovered. Greater effort should be made to do away with mystifiying legal and technical phraseology in our specifications that lead us more often into trouble than out of it. Where we have uncertain information acknowledge the fact and let the contractor bid accordingly, if we insist on unit price bids.

Flood-Proof Bridges for Andes Streams

By Donald G. Coombs
Office Engineer, Construction Department, Braden Copper Co., Rancagua, Chile

DURING the construction of a copper smelter and appurtenances in the Chilean Andes the writer had considerable to do with the transportation of material by mule back. This necessitated trail construction and incidentally a number of small stream crossings. Geographically and geologically this section of the Andes is new, the mountain sides are steep and rugged and the streams fall rapidly. Being at an altitude of 5,000 to 7,000 ft. a few degrees difference in temperature would change snow to rain, with consequent floods of short duration but considerable volume.

With the mule loads averaging 300 lb., and often top-heavy, fords were abandoned and light bridges substituted. These were seldom greater than 20 ft. span so 3 x 8-in. fir stringers were about as heavy timbers as were used. At first simply wood sills in the banks were used. As these washed away dry wall abutments were built from the stream bed boulders. Floods carried these away even though the bridges proper were cabled to adjacent rocks so the third design was adopted as shown in the accompanying photograph.



MULE BRIDGE OVER COYA RIVER, CHILE, BUILT TO WITHSTAND FLOODS

This type of temporary crossing was constructed by hand drilling two holes 4 ft. apart in the rock bottom or large boulders. In these holes were set short pieces of 40 lb. rail with one end forged round for about 2 ft. To the upper ends of the projecting rails were bolted two 3 x 6's. The bridge stringers were then bolted to these cross pieces and the rails grouted in.

This type of crossing has withstood two years of heavy floods and though overtopped several feet a number of times, suffered little—only a few feet of guard rail were lost even though the approach fills have been repeatedly carried away. It is but fair to state, however, that there is very little débris carried by these streams in this immediate locality as the mountain slopes are almost bare of trees.

To the engineering brethren who are headed for south of the equator this is respectfully submitted—the lowly pack mule is the Ford of South America.

Good and Bad Practice in Making Bituminous Patches

Exhaustive Study of Patching Problems Necessary for Best Results; Mistakes and Their Results Tabulated

By John Stanley Crandell,
Consulting Engineer, General Tarvia Department, The Barrett Company

In the spring of 1921 a number of roads will be in bad condition. The average foreman will say: "Well, I patched that road good last summer, and now look at it! The patches have all busted up, and the road's as bad as if we hadn't spent a cent on it. That patching stuff is no good, and I don't want to use any more of it. You're throwing away good money when you use it."

His remarks may be aimed at any brand of material; all have failed at some time or other. But in nearly every case it has not been a matter of the bituminous material failing; rather it is a lack of understanding on the part of the engineer or foreman of the nature of patches in particular. Patching is not a simple art: proof of which is that there are comparatively few perfect patches.

The examination of thousands of patches made with bituminous materials leads me to the belief that only a small percentage are made correctly, and that much better results would be obtained if the road men directly interested would make exhaustive studies of their own patching problems. It is only by watching results obtained with many mixes, under varying conditions, that real information may be collected. This information must then be put to practical use.

Cold Patching Materials—Tars and asphalts are used as binders for patching, and when properly used both

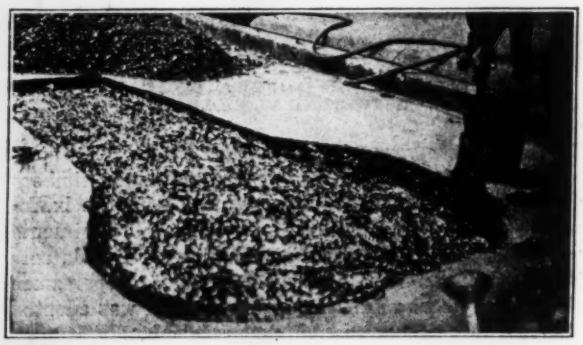


FIG. 1. CORRECT WAY OF PREPARING HOLE FOR PATCH

have given good results. Some engineers prefer the heavy grades that require heating; others like the cold patching materials because of ease of handling. Cold patching materials are of two kinds: emulsions and cut-backs. Emulsions are made by combining bitumen with water, soap and caustic soda so that the resulting material is liquid at ordinary temperatures. Asphalts are usually employed in making emulsions, but the material has the drawback that freezing separates the bitumen and renders it unfit for use.

Cut-back materials are made either from tars or asphalts by dissolving a binder in a proper solvent. The tar cut-backs are, however, more generally used. The solvent is inflammable, and care must be taken to keep cut-backs away from open flames. Serious fires may occur, and the materials themselves are spoiled if they

are unduly heated. They are manufactured so as to be fluid at ordinary temperatures, and the right amount of solvent is added to make them sufficiently fluid except in extremely cold weather. Heating drives off the solvent and increases the viscosity, or "body," to such an extent that the cut-back may be made unfit for cold patching work.

Since cold patching materials may separate somewhat on long standing it is always well to agitate the cut-back

FIG. 2. HOT PENETRATION PATCH

by either rolling the barrels about before using, or by stirring with a stick or rod.

As a rule hot patches are made quite differently from cold patches, and the methods must not be confused.

Hot Patches (Penetration Method)—The easiest way to patch with hot bitumen is to build up exactly as a penetration macadam pavement is made. Clean out the hole as deep as necessary. Fill with clean hard 1½-in. stone. Tamp or roll well. Apply hot bitumen at the rate of $\frac{1}{3}$ gal. per inch depth of stone. Spread ¾-in. stone chips over surface, sufficient to fill voids; sweep off excess chips; tamp or roll. Apply a seal coat of bitumen, ½ gal. to the square yard. Cover lightly with ½-in. chips. Roll.

Mistakes:	Results:
Too much bitumen:	A "fat" patch that will wave, roll, and bleed.
Not enough ¾-in. chips:	An open work patch that holds water and soon breaks up. Allows seal coat to run through to bottom where it is lost in the base.
No seal coat:	Patch is never waterproofed and breaks up in spring thaws.
Too much seal coat:	Patch is soft, or "fat," bleeds and pushes into ridges or waves.
No rolling or tamping:	Patch is never solid; settles below level of pavement after a short time.

Hot Patches (Mixed Method)—A hot mixed patch is excellent if skilled workmen are employed for the work, but almost a certain failure otherwise. It cannot be economically made except in cities and towns where there is a mixing plant, and where there is considerable of this work to be done.

Mistakes:	Results:
Poor quality of aggregate	Patch does not wear like surrounding pavement.
Dirty aggregate:	Patch does not hold together.

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Mix chills before laying:	Uniform rolling impossible, hence a wavy patch.
Bitumen burned:	Value of binder destroyed and patch breaks up.
Too much or too little bitumen:	Equally bad; the former makes a "fat" patch, while the latter makes so lean a mix it will not bind together.
Not rolled enough:	Patch settles, and is not waterproof.

Cold Patch (Penetration Method)—This patch is made as just described under "Hot Patch," but results have, on the whole, been discouraging. Therefore this

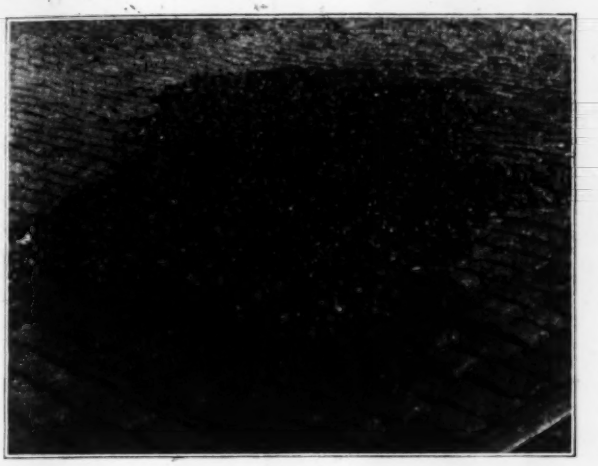


FIG. 3. TOP PATCH CONTAINS NO FINE STONE—BOTTOM PATCH IS FAIR

method had better not be used unless success with it has attended your efforts in the past.

Cold Patch (Mixed Method)—Probably 90 per cent of patching work, exclusive of sheet asphalt patching in large cities, is done this way. The method is simplicity itself, and consequently good results have been obtained despite the mistakes that have been made, and the wilful carelessness often obvious. The procedure in making mixed method cold patches would be: Clean out the hole and sweep it thoroughly. If it is over 2 in. deep, deposit crushed stone in the bottom and bring to within 2 in. of the top, tamping well. Paint the sides of the hole with a light coat of bitumen, using a brush or broom. The proportions of the mix are: Two parts of ¾-in. stone, one part of clean coarse sand or screenings, and just enough bitumen to bind the stone and sand. This amount varies with the materials used. With tar it has been found that about 15 gal. of tar cut-back added to 1 cu.yd. of stone and sand is usually sufficient. A greater amount of asphalt cut-back is necessary. The correct amount must be determined by experiment, and then all mixes should be made alike, if the ingredients are uniform in quality. Mix the stone and the bitumen until the stone is thoroughly coated. Then add the sand. If possible set this mix aside for a few days to season. This permits some of the more volatile fractions to escape, and the mix sets up more quickly when placed in the pavement. Into the hole, prepared as above noted, deposit enough of the mix to slightly more than fill it. Tamp. Cover lightly with screenings. Roll patch with steam or hand roller. If neither of these is to be had use a heavy tamper. Apply a very light seal coat with a brush. Cover with clean chips, sand, or pea gravel. Traffic may be admitted immediately, but it is always better to keep it off the patch for a few days.

Mistakes:	Results:
Large sized stone with no fine material for filler:	A too open mix which has no strength, since the stones touch each other at points only and are not embedded in a matrix. An open mix is not waterproof and ice, forming within the patch, breaks it up in winter and spring, if it has not disintegrated under traffic long before.
Too much bitumen:	A patch that will never set up hard, and therefore rolls and waves badly.
Too little bitumen:	A weak patch that breaks up as soon as laid.
Dirty stone or sand:	A weak mix is certain. Bitumens will not stick to dirty, greasy, or wet surfaces.
Clay mixed with sand:	May form an emulsion in rainy weather.
No seal coat:	Water may penetrate a poor mix, and break up the patch.
Too much seal coat:	Softens patch and causes it to wave, bunch, or rut.
No cover:	May leave an open surface into which water will find its way.
Too much cover:	Kills binding quality of bitumen, or else makes a dusty patch.
Water in the hole before patch is made:	Patch will usually be a failure, never adhering to sides of hole, even though hole eventually dries out.
Use of wet stone and sand:	Bitumen will not adhere, and patch will be a failure.

Before winter sets in all patches should be examined and such as show a surface similar to that in Fig. 3 should be given a light seal coat of cold patch bitumen and a cover of screenings or pea gravel. The patch will then be waterproof, and will go through the winter and spring without further attention.

Often, attention is directed to patches that do not match the pavement. This is, of course, inevitable when bituminous patches are made in brick, stone block, wood

FIG. 4. RESULT OF TOO MUCH BITUMEN

block, asphalt block, concrete, and other such pavements. But when patches are made in bituminous pavements they can be made to match up fairly well. When cold patches are placed in sheet asphalt a very close mix should be made by adding more sand than usual, and the rolled surface should be dusted with portland cement, as is done when the pavement is originally laid. If care be taken in selecting the aggregate, so as to get as nearly as possible the same materials as were used in the construction of the pavement, the patches will not be

obtrusive. A patch made of nothing but large sized stone and bitumen will look out of place in any pavement.

It is becoming more and more the practice to patch holes in brick and in concrete pavements with bituminous materials. Five years ago this was considered a makeshift; today it is acknowledged that the patches are lasting as well as the pavements themselves. But it is only when care is used that such patching is successful. Haphazard workmanship is of no value.

Skin Patching—Breaks in the surface of concrete pavements, bituminous concrete and macadam, and surface-treated plain macadam occur frequently, and repairs must be quickly made if the contiguous surface is not to be broken down rapidly. The usual method is to give the break a thin coat of bitumen, either hot or cold, and then cover with clean chips, or pea gravel.

Mistakes:	Results:
Failure to thoroughly clean the surface of the break:	Bitumen does not stick to dirt or manure, hence the skin coat of new bitumen peels off.
Too thick a coat of bitumen:	A wavy, bumpy surface.
Too much cover:	Kills binding value of bitumen and makes a dead patch that soon breaks up.
Sudden shower immediately after coat is applied: (Cold patch, only.)	May wash off bitumen.

Patches fail because of the use of too large aggregate with not enough "fines"; because of dirty stone, wet aggregate, wet or dirty holes, too much bitumen, too little bitumen, no seal coat, and *no horse sense.*

Patch before winter sets in.

Locating Leaks and Waste in Water Distribution System

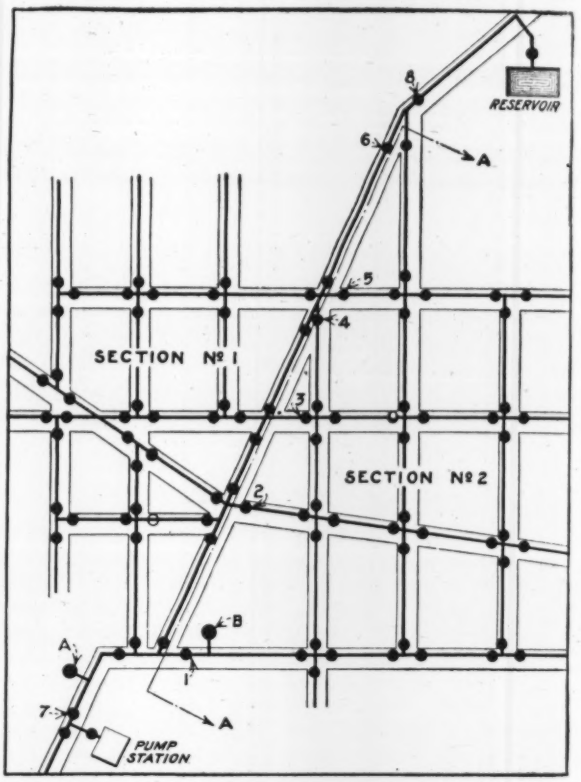
By J. P. Lawyer
Resident Engineer, J. G. White Engineering Corporation, New York City

A COMMON problem which is encountered by the engineer is the determination of whether or not a water-works distribution system leaks and, if it does, how much and where. The most accurate method of determining such leakage is to compare the total reading of all the service meters with the output at the source of supply for a given length of time.

If the services are not metered an estimate of the consumption can be based on the per capita consumption of some similar community, taking into consideration all local features having direct bearing on the use of water.

All distribution systems will show some difference between the amount of water delivered to the system and the amount accounted for. This should not exceed from 15 to 30 gal. per capita per day, depending on the age and condition of the system. Having determined the total difference between the quantity of water deilvered to the system and the quantity accounted for as being consumed and as reasonably "unaccounted-for," the remainder, if any, will represent leakage or wastage which should be located and stopped.

The first step in a simple and satisfactory method of locating leakage or waste is to divide the system into sections which can be segregated by the manipulation of valves. In the accompanying sketch the distribution system has been divided by line A-A′ into two sections. Section No. 1 will first be investigated as follows: Valves 1 to 6 are closed. A standard pressure gauge is attached to Hydrant A and the static pressure observed. Valve 7 is next closed. If the pressure on the gauge attached to Hydrant A falls



DISTRIBUTION SYSTEM DIVIDED INTO SECTIONS

rapidly to zero, it will indicate that there are leaks in Section 1. If the pressure on the gauge remains constant or falls very slowly to 5 or 10 lb. and remains constant at that point for some length of time, it will indicate that Section 1 is free from bad leaks.

In an ordinary distribution system a small static pressure will be maintained by the column of water in the house services for some time after the operating pressure has been dissipated by the loss of a relatively small quantity of water.

Assume that no leaks existed in Section 1 it will be again put in service by opening valve 7. Valves 1 to 6 of this section are left closed and Section 2 is tested in a similar manner, with a pressure gauge at hydrant B, by closing valve 8. If the gauge pressure then drops rapidly to zero we know that there are leaks in Section 2. The next step is to subdivide and continue to subdivide Section 2 until the leaks are bracketed between two valves. As it is necessary that no water be drawn from the mains in the section being investigated while the test is being made, it is advisable to make the tests between 1 and 4 a. m., previously notifying the consumers that no taps are to be opened during that period.

the "Average Engineer"

The ease and speed with which this method can be applied depend largely upon previous preparation of a definite plan, which can conveniently be laid out in advance on a map of the distribution system.

The exact location of the leaks can be determined by any of the methods described by Professor Babbitt in *Engineering News-Record* of May 27, 1920.

How to Check a Drawing

By Samson V. Becker
Architect and Consulting Engineer, New York City

SINCE all drawings are designed to supply information in regard to certain definite objects, the first duty of the checker is to inquire into the "objective" of the drawing. He should obtain this information from one in authority, preferably by first-hand communication or failing in this by checked reference drawings.

General Layout—The checker should not attempt to become familiar with the contents of a drawing during its execution, for he then loses a very valuable "checking" asset; "the first impression." In checking a drawing he should use this asset before it has time to merge into secondary impressions. See that the drawing is laid out in conventional form, that sections of specific parts correspond to their respective plans and elevations and are placed near their relative parts. Make sure that enough sections and explanatory notes are present to sufficiently convey all necessary information. Compare with office standards. See that the location of the object in question is well indicated in respect to base lines, center lines or other conspicuous lines or points. Make sure that these lines or points are readily accessible in the field. Check grades.

Principle—Having verified the general location, next check the principle of the apparatus or construction. If it is constructional, note the particular features of construction; that is, see that doors do not interfere, headroom for stairs, relation between the objects of the construction and the result attained by the methods shown on the drawing. If the drawing is mechanical, check the movements of the apparatus and its parts, capacity, rate of operation, etc. Check for clearances, for strength of construction, for economy, for utility, for material of construction, for practicality and for ease of installation.

Check all detailed parts next. See that parts meet correctly and that dimensions tally with assembly. Clearance for bolts, nuts, etc. Comparison with office standards and with foreign prints and catalogs.

Dimensions and Notes—Endeavor to find the fundamental or starting points of the scheme and check all portional dimensions from this point. From these check all total dimensions.

Notes should cover all obscure and confusing points. In referring to foreign apparatus, etc., use manufacturers' numbers and names and give catalog page and numbers, if available. Avoid all words and phrases not in common use. "Trade" names and descriptions should be used by preference. See that all separate parts have marking letters and the number required noted in obvious reference to same. Avoid labeling two different parts by the same name. All parts of apparatus not "marked" should be named. See that section lines and titles agree.

Check for quantities and material against material list. See that the type and weight of the material conform to the requirements of specifications for the particular job. Make sure that the material listed has not been duplicated on other sheets. Check against requisition. See that the title form and sheet number, scale and client are correctly shown.

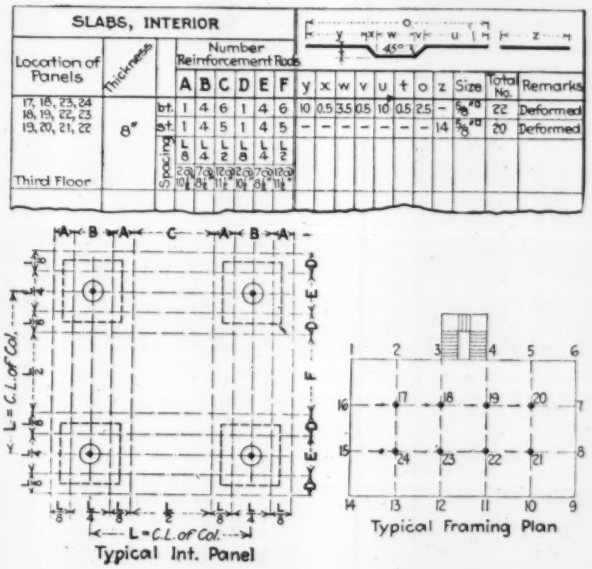
General—The checker should obtain a blue-print of the drawing before starting work. He should adopt a uniform system of checking colors. Yellow for approvals and red for errors make a good system. He should mark out all dimensions, notes, etc., with the correct color and make all corrections and additions in ink. Before turning in the print he should mark on it conspicuously his name and the date corrected, so that the print can be returned later. He should keep a list in a record book of his contact with the drawing and state the client, title, date received, date checked, date back checked and number.

For back checking compare the checking print with the revised tracing. See that all corrections have been made. Check carefully for alterations not listed for revision. Date and sign with initials. Mark all suggestions which have been declined in pencil on the checking print, together with the vetoing authorities' name.

Typical Flat-Slab Working Drawing

By Harold H. Sondheim
Philadelphia, Pa.

DRAWINGS for flat-slab reinforced concrete floors are apt to become complicated and extensive when apt to become quite complicated and extensive when the sizes of floors in one building vary. The accompanying drawings illustrate a typical layout in which



METHOD OF LAYING OUT FLAT SLABS ON WORKING DRAWINGS

simplification is carried to a high degree but which at the same time permits the contractor readily to check up the steel list on the different floors.

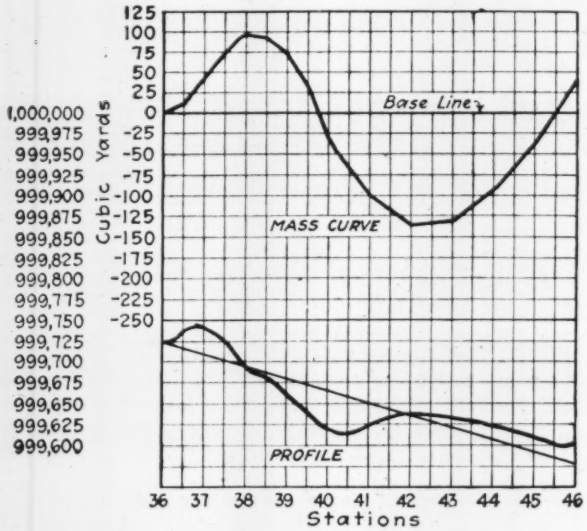
For this example the live-load is 200 lb. per square ft. and the panel 20 ft. square, but provision is made in the blanks for unequal sides. For wall panels the same general arrangement holds, except that the bent bars are hooked at the end.

Mass Curve Ordinates Computed By Aid of Adding Machine

By R. T. Brown
Chief of Surveys, South Carolina State Highway Department

IT IS PROBABLE that many other engineers have had the same experience as had the writer in regard to the use of the mass curve. They have recognized the advantages of using it to aid in balancing quantities and computing overhaul, but on account of the large amount of work required to make the computations, have neglected its use.

In an effort to minimize the work of computing ordinates, by the use of an adding machine the writer



PORTION OF MASS CURVE DIAGRAM

secured results similar to those listed below. Excavation quantities were added, and embankment quantities were subtracted directly on the adding machine. In subtracting, the arithmetic complement of the embankment quantity is listed on the keys and all the nines to the left are depressed as indicated in the table. So long as the ordinate is positive, the sub-total lists the correct ordinate, but when the fill quantities are in excess the sub-total shows the complement of the ordinate with a string of nines to the left. At first these minus ordinates were actually computed and plotted downward from the base line. Later, however, it was found that if the base line were taken as having a value of 1,000,000, the complement of the ordinate can be plotted directly as listed by the adding machine.

EXAMPLE

Sta.	Cut	Fill Increased for Shrinkage	Adding Machine Sub-Totals	Ordinate
36	0.00	.....	.....	0.00
+50	12.50	.....	12.50	12.50
37	28.00	.....	40.50	40.50
+40	26.50	0.00	67.00	67.00
+80	32.00	8.00	91.00	91.00
38	18.50	12.50	97.00	97.00
+50	24.00	28.50	92.50	92.50
39	18.00	36.00	74.50	74.50
+50	9.50	52.50	31.50	31.50
40	3.50	67.00	999968.00	— 32.00
+20	0.00	15.00	999953.00	— 47.00
41	0.00	55.00	999898.00	—102.00
42	11.50	46.00	999863.50	—136.50
43	24.00	18.00	999869.50	—130.50
44	38.50	2.50	999905.50	— 94.50
45	56.50	0.30	999962.00	— 38.00
46	78.00	.....	40.00	40.00
	381.00	341.00		

A Dozen Articles for

In plotting the ordinates shown in the table below those to 39 + 50, inclusive, would be plotted above the base line, as usual. At Station 40, instead of subtracting 999,968 from 1,000,000 and obtaining 32, which would be plotted downward from the base, the 999,968 will be plotted directly, considering the base as 1,000,000.

By having one person hold the computation sheets and call the quantities and another operate the adding machine the ordinates can be quickly computed by this method.

Since the total for cuts and fills will be shown at the bottom of each sheet, the ordinate on any sheet can be checked by adding algebraically the difference of cuts and fills on that sheet to the ordinate at the bottom of preceding sheet.

Simple Solution of Three Highway Construction Problems

By W. B. Walraven
Assistant Engineer, Department of Public Works and Buildings, Division of Highways, State of Illinois

HEREWITH are presented the solutions to three problems frequently met with in the course of highway engineering work. The first is a theoretical treatment of the perpendicular offsets to a horizontal curve at various points along the transit line. It has usually been the practice to use the formula

$$\text{Offset} = 0.875\, n^2\, D$$

where n is the distance in stations along the curve, and D is the degree of the curve. This gives sufficiently accurate results for small values of N and D, but for large ranges it is not even approximate. It also is unhandy for ordinary use in a highway office due to the fact that N is referred to the length of the curve, and not to the tangent.

The writer has sought to find a simple formula which would be absolutely independent of the range of values and which would express N in terms of the distance along the tangent. The first drawing on Fig. 1 illustrates the problem. The formula for the offset is

$$O = R - \sqrt{R^2 - n^2}$$

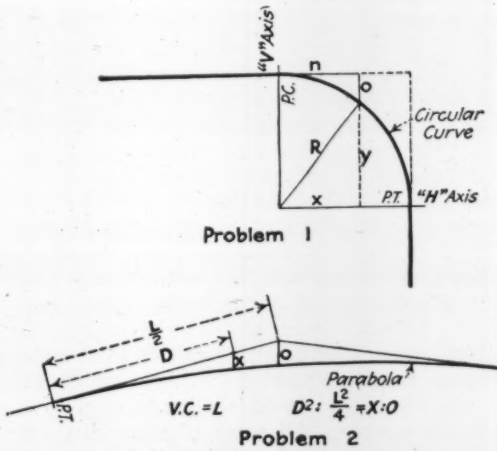


FIG. 1. DEVELOPMENT OF EQUATIONS EXPRESSING CIRCULAR AND VERTICAL CURVES

the "Average Engineer"

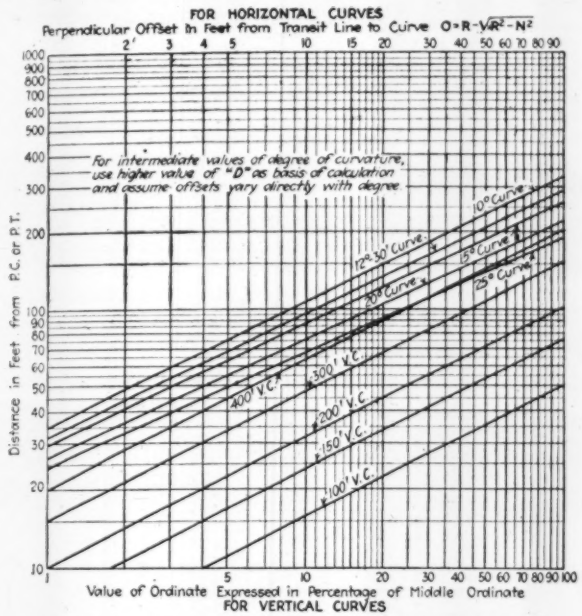

FOR HORIZONTAL CURVES
Perpendicular Offset in Feet from Transit Line to Curve O=R-√R²-N²
Distance in Feet from P.C. or P.T.
For intermediate values of degree of curvature, use higher value of "D" as basis of calculation and assume offsets vary directly with degree
10° Curve
12°-30' Curve
15° Curve
20° Curve
25° Curve
V=300' V.C.
V=400' V.C.
V=200' V.C.
V=150' V.C.
V=100' V.C.
Value of Ordinate Expressed in Percentage of Middle Ordinate
FOR VERTICAL CURVES

FIG. 2. TABLE GIVES TANGENTIAL OFFSETS TO CIRCULAR CURVES AND RATIO BETWEEN ORDINATES IN VERTICAL CURVES

in which O is the offset to a circular curve in feet, R is the radius of the curve and N is the distance from the point of beginning or ending of the curve.

The derivation of this formula is as follows:

The equation of a circular curve referred to two axes at right angles to each other is

$$X^2 + Y^2 = R^2$$

$$Y^2 = -X^2 + R^2$$

$$Y = \sqrt{R^2 - X^2}$$

$n = x$ and $Y = R - O$

Substituting these values, transposing and changing signs,

$$O = R - \sqrt{R^2 - n^2}$$

On Fig. 2 will be found curves showing values of the offset for various degrees of curvature, which are, of course, dependent upon the radii. These values are shown for only a few curves, but values covering the entire range from 0 deg. to 25 deg. may be figured very approximately by assuming that the offsets vary directly with the degree of curvature between any two curves plotted. For example, it is desired to find the offset to a curve of 18 deg. at a distance of 75 ft. along the tangent. The value, referred to a 20-deg. curve, is 10 ft. By proportion, the corresponding value for an 18-deg. curve would be 9 ft. The 10-deg. curve may safely be depended upon to serve as the basis of calculation for all values from 0 deg. up to 10 deg., within a range of 250 ft. along the tangent. If absolutely correct values are desired for any specific case, the investigator should solve the equation for the offset and not trust the reading of a graph, but for ordinary work this chart will be found to be reasonably accurate. In solving the formula for an 18-deg. curve it will be seen that the absolute value of the offset 75 ft. along the tangent is 8.93 ft.

The second problem is the solution of the ordinates to vertical curves at various points along the gradients. The relation of the offsets to the ordinate at the center is so well known that it needs no development here, so the writer has plotted the values without mathematical proof.

The first and second problems are combined on Fig. 2 for the sake of convenience. The chart is logarithmic, with the consequent result that the graph appears as a straight line. This is considered advantageouss, since the intercepts on a straight line are more clearly defined than on any higher form of curve. Other lines may be plotted by solving for the values of any two points and connecting them by a straight line.

The third problem refers to one solution of superelevation of a pavement on a curve from the resident engineer's point of view. It would be difficult to establish any rule concerning the amount by which the pavement should be superelevated on account of varying conditions, but the formula in general usage seems to be

$$S \times R = 0.067\,WV^2$$

in which S is the total superelevation in feet, R is the radius of the curve, W is the width of the pavement in feet and V is the velocity in miles per hour, usually taken as 25.

Fig. 3 illustrates how the superelevation is gained by means of two reverse, vertical curves, the pavement being rotated about the center line. It is good practice to take up the superelevation in from 100 to 150 ft., but this is, of course, liable to great variation on account of local conditions. The proportional parts by which the outside edge is raised and the inside edge lowered are shown for the sixth and the quarter points. For example, assume that the total superelevation is to be 1.5 ft. and is to be attained in a distance of 120 ft. Stakes every 30 ft. will probably be close enough. Beginning at Sta. 0 as shown on Fig. 3, the superelevation is 0. At Sta. $D/4$, or in this case 30 ft. forward, the outside stake is to be set 1.$\frac{5}{16}$, or 0.09 ft. above crown grade at that point and the inside stake lowered by the same amount.

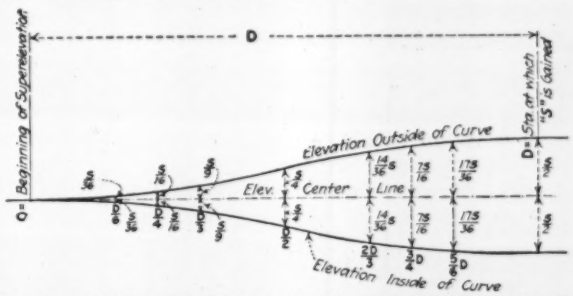


FIG. 3. GRAPHIC REPRESENTATION OF SUPERELEVATION

Attention is called to the fact that these amounts do not take into consideration the crowning of the pavement itself. Naturally, if the pavement were crowned 2 in., both the inside and outside edges would be lowered 2 in. more than would be figured from the diagram. The figures given are applicable only in the case where the superelevation is gained by rotating about the center line. If it is desired to "bank" the outside, and leave the inside unchanged, use the tabular values multiplied by two.

Special Slide Rules Prove Useful in Valuation Work

By C. S. Meyer
Equipment Branch, Valuation Department, Baltimore & Ohio R.R., Cincinnati, Ohio

IN calculation work involving the use and repetition of definite formulae or in which the cost of material such as belting, cold-rolled steel shafting, etc., varies gradually and definitely with the increase in size of the article, the special slide rule finds instant favor. If the variation of cost with size is plotted with size as abscissae and cost as ordinates, the equation of the curve resulting can be derived and when once derived forms the basis for the construction of the special slide rule. In fact, any calculation or series of calculations which can be represented by an equation can be transformed into a special slide rule on which, by the simple process of moving the slider or sliders, the solution of the equation and hence the results sought can be obtained.

The special slide rule, once constructed and checked, obviates the need of the price list in valuation work; minimizes the chances of error in calculation and while not attaining the degree of accuracy obtainable by the slow long-handed method of calculating, is as accurate as our ordinary polyphase slide rule. A special slide rule, then, is a slide rule constructed for the purpose of solving one particular formula which represents a definite curve. Such a rule cannot be used for any other purpose or formula unless adapted to meet the conditions.

The apparently intricate method for the evolution of special slides is not difficult, as the following discussion will show. One case, the description of which follows, is that of a special rule designed to determine quickly and accurately the cost of a piece of two-ply leather belting, when the length and width of the belt are known.

In the first place, the only material available and necessary was a price list of two-ply leather belting of the year 1914, at which time prices are taken in the work of railroad valuation. Using the width of the belt as abscissae and the cost per foot as ordinates, a curve was plotted on rectangular cross-section paper and is shown in Fig. 1. Next, using the same values for abscissae and ordinates but plotting the values on logarithmic paper, a curve is obtained which approximates a straight line as shown in Fig. 2. To anyone familiar with the properties of logarithmic graph paper it is known that, if the curve is a straight line, the value of the slope is the exponent of the variable. By the slope of the curve, as well known, is meant the ratio at any point of the ordinate to the abscissae: In other words, the tangent of the angle made by the curve with the X axis. Since the curve approximates a straight line, it is of the form,

$$y = Kx^s$$

where s is the slope of the line, which, from the curve is,

$$S = \tan^{-1} 45.5^\circ = \frac{1.5}{1.46875} = 1.02$$

The equation then becomes very approximately,

$$y = Kx$$

To find the value of K, substitute values of x and y, that is abscissae and ordinates, from the original curve, Fig. 1. The average value of K is 1.08.

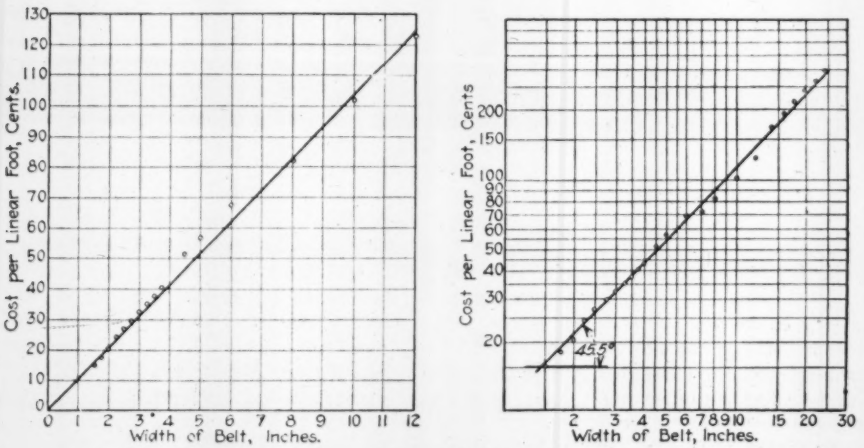
Hence, the equation becomes

$$C' = 1.08W$$

where C′ is the cost per linear foot in dollars and W is the width in inches.

With the equation established, the actual determination of the scales with the proper graduations is the next step. This is a rather long but simple operation which space will not permit to be explained here.

The finished special slide rule is shown in Fig. 3. The method of using the rule is as follows:



FIGS. 1 AND 2. RECTANGULAR CO-ORDINATE AND LOGARITHMIC CURVES OF COST OF BELTING

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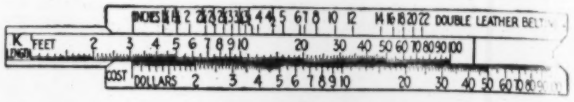
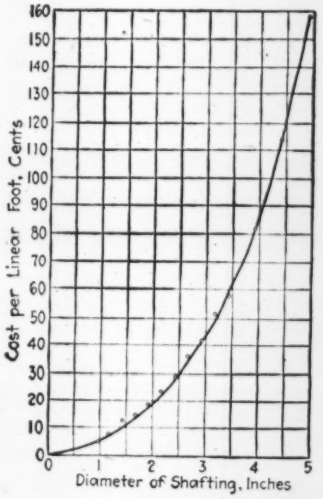
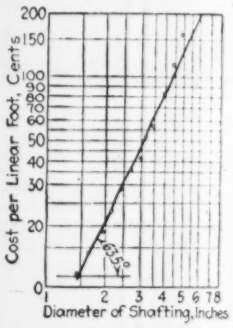


FIG. 3. SPECIAL SLIDE RULE TO DETERMINE COST OF TWO-PLY LEATHER BELTING





FIGS. 4 AND 5. RECTANGULAR CO-ORDINATE AND LOGARITHMIC CURVES OF COST OF COLD ROLLED SHAFTING

The "Average Engineer"

Bring the vertical arrow on the K scale to the number on the upper scale (width), and below the length in feet read the corresponding cost in dollars on the lowest scale. Fig. 3 shows the scales of the rule in their proper position to determine the cost of a piece of three-inch two-ply leather belting 30 feet long, which is $9.72.

In like manner a slide rule was constructed to determine the cost of cold-rolled steel shafting which

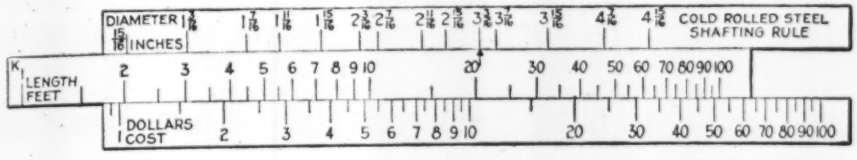


FIG. 6. SPECIAL SLIDE RULE TO DETERMINE COST OF COLD ROLLED SHAFTING

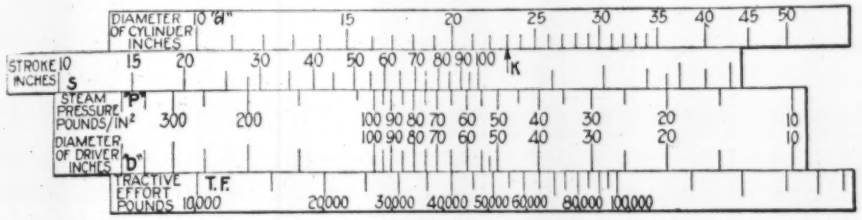


FIG. 7. SPECIAL SLIDE RULE TO DETERMINE TRACTIVE EFFORT OF LOCOMOTIVE

Assumes use of the formula: T.F. = 0.85 Pd²S/D where T.F. equals tractive effort in pounds; d equals diameter of cylinder in inches; P equals steam pressure in pounds per square inch; S equals stroke of piston in inches; D equals diameter of drivers in inches.

curve is plotted on rectangular cross-section paper, Fig. 4, and also on the logarithmic paper, Fig. 5. The equation of the shafting curve, following the same method of procedure, as already given in detail, is that of a parobola of the general form,

$$x^2 = Ky, \text{ which, in this case, is, } \quad C = LD^2/K$$

where, C is the total cost in dollars, L the length in feet, D the diameter in inches, and K the average constant, which is 20.39.

The equation is consistent with the fact that as steel shafting or any round stock is sold by weight, the weight, and consequently the cost, varies as the length and as the square of the diameter. Hence it follows that this slide rule is adaptable for any round stock material, the use of the correct value of K being the only requisite.

The resulting special slide rule is shown in Fig 6. The scales of the rule are in the proper position to determine the cost of a piece of 3⅞ in. diameter cold-rolled steel shafting of any length. A piece 30 ft. long, for example, will cost $15.45; 40 ft., $20.60.

The possibilities for the further development of more complicated slide rules are indicated in Fig. 7 showing a rule to determine the tractive effort of a locomotive from the formula:

$$\text{T. F.} = 0.85\ P\ d^2\ S/D$$

This rule is a good example of the solution of formula involving several variables.

The sketch shows the rule set to determine the tractive effort of a locomotive with cylinders 23 x 28 in., boiler pressure 200 lb., diameter of drivers 52 in., giving the result as 48,400 lb. The scales representing the stroke, steam pressure and driver diameter slide between fixed scales representing diameter of cylinder and tractive effort.

Estimating Small Sewer Jobs

By W. Earl Weller
City Engineer, Binghamton, N. Y.

Because of the tendency of the engineer to underestimate the cost of construction work the preliminary estimate has become a source of friction between supervising engineers and contractors. Many an engineer as well as many a contractor has had cause to rue bitterly a carelessly considered or a too optimistically computed preliminary estimate. Especially is this true in municipal work where the penalty of a high preliminary estimate is the unpleasant experience of seeing a short-sighted legislative body refuse the funds for necessary construction. Perhaps an over-anxiety to make a project appear in its best light to a group of aldermen is the impelling reason for the chronic underestimating by municipal engineers. Whatever the cause, engineers should bring themselves to realize that the preliminary estimate is a most important part to any plan for construction work and that it is not a feature that may be neglected up to the very last minute and then rushed through in a haphazard manner. A moment's consideration will prove that a low preliminary estimate encourages inexperienced contractors to underbid a job to the detriment of the job itself and of all concerned and that it places the experienced contractors before the public in a most unfavorable light.

In connection with the more important and more costly work there is usually time, if the engineer will take it, to estimate most carefully the probable cost of the construction, but with the smaller jobs, more or less routine in their manner, time may actually be lacking for preparing a proper estimate. Two methods are then open to the engineer for arriving at a probable estimate of the cost. Either he may make a guess based on his personal experience or he may trust to the ability of one of his subordinates. In the ordinary office either course is dangerous and in a majority of cases will lead to embarrassing situations. A method of estimating the ubiquitous "V. T." sewer has been in use by the Bureau of Engineering of Binghamton, New York, for the past three years and has proved so satisfactory from the standpoints both of time and of accuracy that a brief description may not be amiss.

At the end of each construction season a careful analysis is made of the unit prices bid by the various successful contractors for the small sewers. These prices are tabulated as shown in the accompanying table, the second column giving the total number of units and the last column the total cost of each item for the season. From these figures are derived the average price to the city of the various items. The maximum and the minimum bid prices of successful contractors for the various items are also recorded in the table. These figures multiplied by the ratio between the cost of 8-in. pipe at the time the estimate is being made

and the average cost of 8-in. pipe during the season covered by the table are used as the unit prices for the preliminary estimate during the following season. Minimum, average or maximum prices are used depending on the nature of the soil to be encountered.

SEWER COST (1919), BINGHAMTON, N. Y.

Item	No.	Unit	Price Max.	Price Min.	Price Avg.	Cost
8-in. sewer 0- 6 deep...	659.7	lin.ft.	1.20	0.93	1.08	717.36
8-in. sewer 6- 8 deep...	5,633.9	lin.ft.	1.26	1.10	1.22	6,871.83
8-in. sewer 8-10 deep...	1,236.0	lin.ft.	1.45	1.20	1.37	1,698.45
10-in. sewer 6- 8 deep...	121.0	lin.ft.	1.45	1.45	1.45	175.45
10-in. sewer 8-10 deep...	802.0	lin.ft.	1.65	1.50	1.58	1,235.40
10-in. sewer 10-12 deep..	260.0	lin.ft.	3.12	1.92	2.15	559.20
10-in. sewer 12-14 deep..	156.0	lin.ft.	4.00	2.25	2.31	361.50
10-in. sewer 18-20 deep..	42.0	lin.ft.	6.00	6.00	6.00	252.00
12-in. sewer 0- 6 deep..	1,155.0	lin.ft.	1.20	1.20	1.20	1,386.00
12-in. sewer 6- 8 deep..	98.0	lin.ft.	2.00	2.00	2.00	196.00
15-in. sewer 6- 8 deep..	101.0	lin.ft.	2.10	2.10	2.10	212.10
15-in. sewer 8-10 deep..	59.0	lin.ft.	2.90	2.90	2.90	171.10
15-in. sewer 10-12 deep..	121.0	lin.ft.	4.00	4.00	4.00	484.00
30-in. sewer 0- 6 deep..	662.0	lin.ft.	5.35	5.35	5.35	3,541.70
30-in. sewer 6- 8 deep..	581.3	lin.ft.	6.00	6.00	6.00	3,487.80
30-in. sewer 8-10 deep..	524.0	lin.ft.	7.06	7.06	7.06	3,699.44
30-in. sewer 10-12 deep..	28.0	lin.ft.	8.50	8.50	8.50	238.00
Laterals	6,268.0	lin.ft.	1.00	0.62	0.69	4,378.76
Branches	338.0	each	2.20	1.02	1.86	630.18
Manholes	48.0	each	60.00	48.00	52.50	2,520.00
Manholes (ex. depth)....	73.4	lin.ft.	7.00	4.25	5.45	399.75
Catch basins	21.0	each	130.00	115.00	125.71	2,640.00
Inlets	6.0	each	35.00	35.00	35.00	210.00
10-in. connections	126.0	lin.ft.	1.70	1.70	1.70	214.20
Replacing pavement	36.3	sq.yds.	3.40	3.40	3.40	123.42
Concrete	15.5	cu.yd.	10.42	10.42	10.42	161.51
Removing catch basins...	6.0	each	25.00	25.00	25.00	150.00
Extra work	.....	....	.....	.....	.....	1,878.45
Inspection	.....	....	.....	.....	.....	660.00
Total length of sewers						12,239.90 feet
Total cost						$39,253.60
Total cost without appurtenances						25,287.33
Cost per foot						3.21
Cost per foot without appurtenances						2.06
Percentages of cost:						
Sewer proper						64.42%
Laterals						12.76%
Appurtenances, excluding laterals						14.70%
Extra work (cost plus)						4.78%
Special work (bid prices)						1.65%
Inspection						1.69%

The method has proved exceptionally satisfactory during its three seasons of use. It is practically automatic and yet is flexible enough to meet varying conditions. For instance, it is possible in any particular case to judge how sharp competition for the work will be and to modify the unit figures by a ratio to meet this condition. The accuracy of the estimates so derived is surprising. The method is further extended for the purpose of furnishing snap figures for committees and boards that must have some fairly accurate estimate of the cost of these small sewers before even the survey is authorized. For this purpose a composite price per foot of the previous season's work is derived and this figure multiplied by the ratio stated above and the resulting product multiplied by the probable length of the sewer. The cost of a group of small sewers thus estimated will usually be from 90 to 95 per cent of the estimated cost, a most satisfactory condition. The method has been a saver of time and an avoider of those petty heart-burnings that are bound to follow a poor preliminary estimate. It is possible to apply similar methods to a large percentage of ordinary municipal construction.

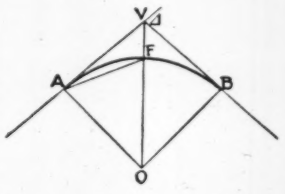
Salt River Bridge Completed

Completion of the bridge over the Salt River, on the Salt River-Pleasant Valley road in the Tonto National Forest, Gila county, Arizona, has been announced by T. W. Norcross, chief engineer of the U. S. Forest Service. This bridge makes unnecessary the operation of the dangerous ferry across Roosevelt Lake.

A Method of Setting Out Curves

By Walter H. Drane
Chief Engineer, Smith County Highway Commission, Carthage, Tenn.

In staking out curves in railroad and highway location work, much time is often consumed in selecting the proper curves and in fitting them to the ground. In the accompanying figure, the usual problem presented after locating V and measuring delta, is to determine D and the PC of a curve to run through some selected point F, the curve being then figured from fieldbook tables. In brushy country, besides the labor of figuring, this often necessitates several settings of the instrument, with loss of time, and the method suggested below may prove useful.



Suppose the V and delta have been determined in the usual way and that the degree is figured from the tables as usual by selecting arbitrarily the point F in the secant through which it is desired that the curve shall pass. Locate F carefully by turning off an angle $\frac{1}{4}(180 - \Delta)$. Move the instrument to F, orient on V and turn off the angle $VFA = 90° + \frac{1}{4}\Delta$. Now $FA = 2Rs$ in $\frac{1}{2}\Delta$. This locates A and the curve can be staked in by the usual method of deflections from F. If a check is desired, T may be computed from the tables and compared with the measured T (A V).

There is nothing new in this as to geometry. Its possible advantage is that very often the entire curve can be staked easily in both ways from V, while obstacles would require several settings for the ordinary procedure. Another advantage is that F is usually much nearer V than either A or B, so that the instrumentman has much less distance to walk.

Making Macadam Surfaces Durable Type Bases

At the 26th annual convention of the American Society of Municipal Improvements held in St. Louis, George C. Warren, of Warren Bros. Co., set forth the value of conserving old macadam as a foundation for durable bituminous surfaces. Some of the points upon which he laid emphasis are given herewith:

1. The macadam must be real macadam of either stone or gravel of substantial strength, or must be reinforced with additional stone.

2. Make test holes across the road at intervals of about 100 ft. immediately in advance of construction for deciding the necessity of a depth of new metal.

3. Such reinforcements required to be paid for by the ton or cubic yard and bids should be taken on that basis, due to the impracticability of determining in advance exact quantities needed.

4. Do not disturb the old macadam for grade or contour changes unless absolutely necessary.

5. In every case where there is any road metal on the road or street, however thin or weak it may be, it is better to conserve it than to remove it.

6. If the test excavation develops that six inches or more of solid metal are present in which the coarse aggregate—above one-quarter inch in size—is more than one-half the total metal, no treatment is necessary or advisable except to smooth out irregularities in grade.

7. If the above condition does not exist and fine particles predominate less labor and cost will be necessary to increase the depth of the old surface after regulating the grade whatever depth of new metal intelligent consideration indicates to be best.

Trend of Highway Development —A Survey

THIS IS THE SIXTH of a series of staff articles on the highway situation. It discusses Maine's construction and maintenance of plain and surface-treated gravel roads, and the legislative measures that have given the towns in the state opportunity of initiating construction on connecting systems.

The seventh article in the series will appear in next week's issue.—EDITOR.

Maine's Practice

ATTENTION to the details with which Maine has so successfully built and maintained an extensive system of plain and surface-treated gravel roads is liable to eclipse other important considerations of her highway practice. Yet no inquiry into Maine's highway development can justly ignore the various highway measures that have induced almost every town in the state to assist in the construction of either state or state-aid roads.

Several factors contributed toward the extensive use of gravel surfaces on not only third-class roads but on the state and state-aid highways as well. In the first place, the large mileage of roads and the sparse population precluded the possibility of securing money with which to construct an elaborate system of any so-called durable types. Then, there is locally available pit gravel at a maximum haul of five miles. That distance has been exceeded at times in maintenance work but seldom on construction, and most projects have been completed with an average haul of from two to three miles. With these conditions existing, Maine has developed a system of plain gravel and surface-treated gravel roads that comprise approximately three-fourths of its 4,300 miles of state and state-aid roads, and which in some cases, carry during a four-months summer season as high a daily average as 3,500 vehicles of all types.

DEEP FROST PENETRATION

One of the first facts to be noted in highway work in Maine is that there is a frost penetration of from 4½ to 6 ft., and in at least one case a penetration of 7 ft. has been noted. It is apparent, then, that the drainage must be carefully planned. In this connection it may be said that Maine does not believe in snow removal, and for two reasons: Because taking the snow from the highways would endanger their integrity through the removal of the protecting blanket against the most excessive frost penetration; and, because those who make winter use of the highways are, with few exceptions, prepared for the deepest snow.

Twelve different types of gravel road have been developed, so that every variation in subgrade is overcome and a surface secured with has successfully withstood heavy traffic. In general, upon the graded subgrade are placed from 2 to 4 in. of pit gravel. Upon that is laid one or several courses of quarry or field stone not more than 8 in. in largest dimension. This stone base is sometimes laid to a depth of 24 in., rarely 30 in., and usually about 10 in. This foundation course is hand laid and then filled with clean gravel, broomed, and rolled intensively, the aim being to fill to as great an extent as possible the voids in the stone base and to compact it thoroughly. A screened gravel surface of a depth varying between 6 and 11 in. is then laid.

For an 8-in. top surface, which is the usual depth, the gravel is laid in three courses. The first course is composed of 1-in. to 3½-in. gravel of a compacted thickness of 4 in.; the second course of ¼-in. to 2-in. gravel of a compacted thickness of 3 in.; and the top course of ¼-in. to ¾-in. gravel, of a thickness of 1 in. The first two courses of this top layer are clay bound, the pit gravel usually containing enough clay to secure a thorough bond.

KEEPING CUSHION ALIVE

Practically the entire success of gravel roads in Maine depends upon the laying and maintaining of the top 1 in. of the 8-in. gravel surface. Only the cleanest gravel is used. It is not rolled but kept continuously alive, that is, never allowed to become consolidated, thus always serving as a cushion coat to protect the bonded courses beneath it from the action of traffic. Were consolidation of the top allowed to occur it is pointed out that the whole road might soon shred or break up under traffic. Evidently careful selection of gravel and well-nigh perfect patrol maintenance are necessary.

Variation from the general method of construction is made where the vertical, natural drainage is good. In that case the stone base may be omitted. Again, drainage may be secured best through either a V-drain under the metaled surface or by a stone-filled side drain. In the former case the stone base attains a depth of 24 in. In the latter case a trench is dug, 10 ft. from the road center line, to a total depth of 4½ ft. below the finished grade. The bottom width of this trench is 18 in. and its top width 24 in. It is filled with stone uniformly graded from 6 in. at the bottom to 1 in. at the top course. Other variations from the general type of construction include the use of gravel containing large stones for foundations, sometimes to a depth of 11 in. where the subgrade does not need a stone base yet indicates that an 8-in. surface of fine gravel will not be sufficient. Gravel is also laid either with a feather edge, providing a 2½-ft. shoulder, or laid only to an 18-ft. width. Up to last year a uniform metaled width of 16 ft. was standard, a width that has been increased during this year to 18 ft.

It is considered good practice to gravel a road and leave it for from three to four years, even though hard surfacing is contemplated, so that, should there have been sections of road overlooked in the original design of drainage or foundation structures, weak spots may be eliminated before any costly surfacing is put down. When a road demands improvement through the laying of one of the so-called modern types of pavement, the gravel remains as the base for the new topping. Bituminous macadam, concrete and stone block have all been laid upon gravel roads with excellent results. Bituminous macadam is the most frequently used of the so-called durable types.

ORGANIZATION

The state highway commission has jurisdiction over the maintenance of all state and state-aid improved and unimproved highways. The commission is so organized that the construction of state roads is accomplished by one division. Another has the construction of state-aid highways, and these two, together with the bridge, maintenance and accounting sections, form the five divisions of which the highway commission is composed. State-aid construction and maintenance are

more or less correlated inasmuch as the same supervisors who superintend specific state-aid jobs, have supervision over the maintenance work within the twenty-three supervisory districts.

The first maintenance operation upon gravel roads in the spring is shaping and blade-grading, accomplished as soon as the weather permits. After the road has been shaped, from 1½ to 2½ in. of clean, fine gravel is placed upon the road crown. This work is accomplished usually by fifteen-man gangs operating from four to six trucks, gravel loaders, gravel spreaders, etc. Usually from eight to ten of these gangs operate in the early spring. When this work has been finished, the same gangs put into stockpiles along the roadside the clean gravel which is to be used for maintenance during the rest of the season by the patrolmen, of which the state has approximately five hundred operating under the direction of the twenty-three supervisors. All but ten patrolmen operate single teams. Those ten form the nucleus of motor-truck-patrol gangs used on the maintenance of surface-treated gravel roads. Though the amount of territory covered by each patrolman varies greatly at times, the average length of improved and unimproved state and state-aid roads that each covers is eight miles.

Surface-Treated Gravel

Surface treatment of gravel roads is usually begun when a road takes a traffic of from 400 to 600 vehicles per day. The surface treatment is done on state roads only. The treatment begins during May, June or July, depending upon the weather and the place in the state in which the road is situated. Cold bituminous material is almost invariably used. Preliminary to the treatment of the road the surface is swept with horse-sweepers and then hand broomed, and thoroughly bonded. The first treatment is of approximately ½ gal. of bitumen to the square yard, upon which is spread sand, 40 to 50 cu.yd. per mile being used. With some patching that single application will usually carry a road through the first season. During the second season an average of 0.3 to 0.4 gal. of bitumen per square yard and the same quantity of sand as is used in the first treatment, are applied. Such treatments continue for four or five years. It has found that this repeated seasonal bituminous treatment unavoidably leaves, after a time, lumps of bonded material that make the road uneven. Therefore it is considered best to scarify the road and remove the surface to a depth of 3 to 4 in. These pieces of bitumen and gravel are carried to the roadside with a road machine and the road is again smoothed, planed and crowned. A small quantity of this scarified material is first brought back to the crown and allowed to consolidate under traffic. This process goes on throughout the entire season until all of the scarified material is again on the road. If traffic does not thoroughly consolidate it, it is rolled, and if it needs to be bonded, a little clay is added. When all of this material has been brought back upon the road surface from 0.2 to 0.3 gal. per square yard of bituminous material is applied, then covered with sand, 40 cu.yd. to the mile being used. Sand for this purpose is placed at the roadside in piles approximately 30 ft. apart, and the bituminous material is applied with truck distributors. At times it has been found necessary to heat the bitumen but never is it heated in excess of 100 deg. F. When the temperature is between 70 and 80 deg. F., or thereabouts, the bituminous material is always applied cold. The patching of bituminous surface-treated gravel roads is accomplished by truck patrol, team patrol being used upon plain gravel roads.

In the maintenance of surface-treated gravel roads particular attention is given the amount of bitumen applied. Application of a uniform quantity over any great length of road is rare. On the other hand, the bitumen applied may vary from ⅛ gal. to ½ gal. per sq.yd. within short distances and from one side of the road to the other. Spots may be encountered that need no treatment, then again more than the average application is necessary. *The practice is not to apply uniform quantities but to put the bitumen where it is needed*, and the superintendent of maintenance has exercised the greatest patience in instilling into his maintenance gangs the economy and efficiency of such practice.

To indicate the care with which gravel-treated roads are maintained, practical examples are given, which indicate to those in charge of the treatment the necessity of putting the bituminous material where it is needed. For instance, the superintendent of maintenance has frequently followed surface-application gangs. If he finds that puddles of bituminous material are being left, he stops the distributor and in each of these puddles of bitumen he throws a ten-cent piece. He then calls the man who is applying the bitumen and shows him the puddles and the ten-cent pieces, telling him that each puddle of bitumen means practically a ten-cent loss. In other words, he is throwing money away through injudicious application of bitumen and such a practical lesson need be given, in most cases, but once.

Close Scrutiny Given Surfaces

The superintendent of maintenance has, frequently, in going over roads which have been surface treated, used a magnifying glass to discover whether the road needed re-treatment. If any hair lines appear around protruding stones he knows re-treatment will soon be necessary and that if such spots are allowed to go until any appreciable moisture comes to the road surface, the integrity of the bond is endangered.

It is a rule in Maine that no bituminous material shall run to the sides of the road. If the bitumen distributor gets too far ahead of those doing the sand covering the first operation stops until the shovelers and rakers catch up. Then, better than put too much bitumen on, it is thought better to put too little on and make a re-treatment if necessary. However, practice in Maine has reached such an art that almost invariably the exact amount of surface treatment is done upon the first application. If, when treatment is begun, the road surface shows a hard stone, it is thought best to use less bitumen and sand and let the hard points of the stone take the wear of the traffic; whereas in the case of soft stone it is better to cover it up and let the bituminous mat take the traffic.

Maine began its construction of state roads (now state-aid roads) in 1901. Full control of the roads to be improved and the sort of construction to be followed lay with the sixteen county organizations. In 1908 these state-aid roads were put under the control of a single commissioner though the state itself did not begin the construction of roads until the formation of the present commission in 1913. In that year when the commission was organized a constitutional

amendment was also passed authorizing $2,000,000 of road bonds, the funds to be spent in four years—$500,000 per annum. That money was for construction of state highways solely, maintenance money being secured from the motor-vehicle license tax. After the $2,000,000 bond issue was expended the state highway fund was provided by a tax of one mill on each dollar of valuation in the state. With the prospect of increased Federal aid in 1919 another constitutional amendment was passed, allowing for an increase in highway indebtedness of $10,000,000. Bonds were to be carried by, and retired from, motor-vehicle tax fees. At the same time the mill-tax highway fund, excepting a small fraction, was diverted to other uses, such as third-class highway improvement, and to certain special jobs that the legislature might direct. The remainder of the vehicle tax left after providing for bond interest and sinking fund, is used for maintenance purposes, and the residue of the mill tax for either construction or maintenance.

Two recently enacted highway acts have tended to stimulate widespread construction upon state and state-aid highways through the initiative of the towns. The first of these is what is termed the third-class highway law. Through its provisions any town whose individual appropriations for road work have, during a period of five years, been an average of four mills, may, if the sixth year, the year in which money is applied for, equal the five-year average, apply for money made available by the state for such purposes. A sum of $10 per mile is procured through a six-year average expenditure of four mills, and for every mill above four an additional $1 per mile is given. The other act is the three-town highway law. When any three towns agree to the improvement of a highway connecting them, they can avail themselves of state aid through an appropriation of a sum equal to that named in the law, a sum which varies with the valuation of the town. If the towns make twice that base appropriation they receive twice the sum from the state plus a 25 per cent bonus; if three times, three times the amount from the state with a 50 per cent bonus; if four times, four times the amount and a 75 per cent bonus; and if five times, five times the amount plus a 100 per cent bonus.

Stimulus Given Towns

The first of these laws designates that the money may be used either upon third-class roads or upon state-aid roads, and the second law allows the expenditure to be made upon any class, including state roads. Both of the laws, and particularly the three-town law, have greatly stimulated road building throughout the entire state, and not only are the taxpayers at large carrying a comparatively heavy tax burden in the state bond issue, but they are vying with each other to secure the available appropriations from these two aid laws. The construction work executed under these laws is supervised by the highway commission. The laws have stimulated widespread construction upon state and state-aid connecting systems by towns, for the great part of all three-town-highway money is being expended upon such construction.

Maine is apt to be regarded as one of the small New England states, a fact which would perhaps minimize the importance of her success in building and maintaining a large mileage of gravel roads. One statement will suffice to place Maine as to size: From Fort Kent near the Canadian border to Kittery, at the New Hampshire line, running through the center of the state is a trunk-line highway which forms the backbone of the highway system. That road is of the same length as the most direct route from Kittery to Baltimore, Md. Therefore Maine's problem is the problem of the large, sparsely-populated Middle-Western state, but her treatment of the problem is distinctly her own.

Relation of Reservoir Storage to Conduit Capacity

By F. B. Marsh
Water Supply Board, Providence, R. I.

THE article in *Engineering News-Record*, July 22, p. 153, by Frederic H. Hapgood on the "Estimation of Conduit Capacity in Relation to Storage" calls to mind a similar problem of the Catskill water system for New York City which arose in 1906 in connection with the determination of whether it would be more economical to develop storage for the Schoharie watershed locally or increase the size of the tunnel to carry this water to the Esopus watershed and provide the requisite storage capacity by raising the flow line of the Ashokan reservoir.

This question of relative economy was solved by what was called, at the time, the "parallel tangent theorem." Having determined the total storage needed to develop the watershed there was prepared a curve showing the total cost of the so-called Schoharie reservoir for various capacities up to this total and similarly a curve of the cost of raising the flow line of Ashokan reservoir so as to obtain equal amounts of storage was prepared. In addition a curve of total cost of the Schoharie tunnel was plotted showing its increase in size, and therefore in cost as the amount of storage in Schoharie reservoir was decreased and the amount of storage in Ashokan reservoir increased, the total of the two always remaining the same. This curve of cost of the tunnel was then added to the curve of cost of storage in Ashokan reservoir. The most economical amount of storage to develop locally in the Schoharie reservoir was determined by finding the points on this combined curve and the curve of Schoharie storage, the tangents to which were parallel at the same time that the total storage was the amount necessary properly to develop the watershed.

This made a very neat solution of an otherwise tedious problem. This work was done under the direction of the writer as designing engineer of the New York Board of Water Supply but I am not sure who was the author of the "parallel tangent theorem." In any case the patents on it have probably expired long since.

Unemployment on the Job

Dr. Royal Meeker, until recently chief of the Bureau of Labor Statistics, has applied to indifferent service on the part of labor the term "unemployment on the job." He classifies unemployment in three groups:

1. Seasonal unemployment, due to the seasonal characteristics of industry or business. (Many of the construction industries would be typical examples of this sort.)

2. Sporadic unemployment, due to various causes occurring at irregular and unforeseen intervals, and

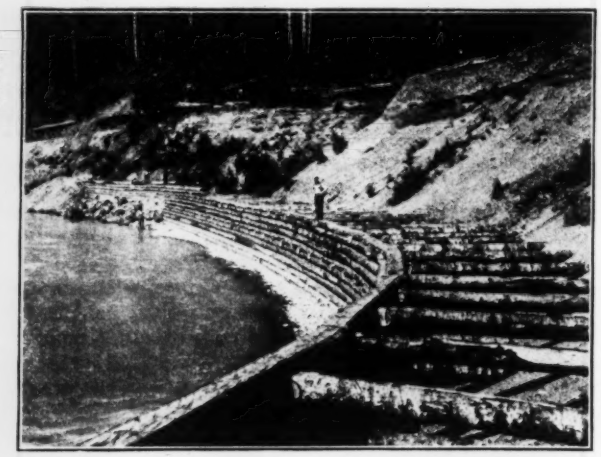
3. Unemployment of hard-times.

Observations on a Pacific Coast Trip

By Frank C. Wight
Associate Editor, *Engineering News-Record*

Seattle's Post-War Problems

SEATTLE is depressed but not downhearted. The depression is economic, partly a reflection of the general condition of the country and partly a local reaction following the cessation of war activity. The uplift of heart is spiritual and is part of the genius of the city, a spirit born in Alaska's boom of the nineties which transformed a frontier town to a city with visions of world greatness. It is more than mere poetic fancy to personify a city. They all have distinct personalities—in the older ones, perhaps, not so marked but in these great cities of the West quite inescapable. In Seattle the common aim toward growth is so obvious as to lend its flavor to the whole community. The vision is unconcealed—to become by virtue of its harbor, its proximity to Alaska and its slight time advantage



TIMBER CRIB SIDE HILL WORK ON SKAGIT RAILWAY

across the Pacific the great port on the east shores of that ocean. In fact, the common vaudeville joke in the competing neighbors to the south is to call New York "the Seattle of the East."

During the war Seattle was one of the busiest centers in the country. Great shipyards set records in construction far ahead of cities where shipbuilding had been a trade for decades. From it as a center went out the efforts of the spruce production army for aircraft. Just to the south of it lay the one big cantonment of the West; and to and from its crowded wharves came and went a large part of the enormous war traffic of the Orient. Boom times beyond the wildest dreams of even Seattle were upon it.

Shipyards Idle

Now the shipyards lie idle, workmen and their families to the number of 50,000 have left town, aircraft is no longer required, the soldiers have put on "civies" and the Orient is, for the time being, dead. Where once the Smith's Cove piers were crowded and packed with oils coming in and steel and munitions going out, now a lone steamer unloads rattan alongside half a dozen of its fellows tied up awaiting business. Because people must eat, good times or bad, the great fish trade of the Northwest continues to flourish and the enormous fish wharves with their thousands of boxes of canned salmon and their, one would almost say, millions of huge frozen halibut and salmon are crowded to capacity. In this one staple the port is very busy.

But Seattle is not discouraged. It counts the letdown of war business an expected sequel of peace and it looks forward with characteristic optimism to an early development of its natural resources. Two fields are particularly encouraging—besides the field of irrigation common to all the West, which, while discussed in engineering circles in Seattle, is not so prominent there as in Spokane and Portland. These two fields are water-power and paper-pulp production.

The latter is especially promising because of the great quantities of standing timber in the country, mainly in the peninsula across Puget Sound and on the lower Alaskan coast line. Near Port Angeles, for instance, small mills are already being enlarged and great projects are under way involving the use of the railway built but never used for the production of wood for airplanes. Near Juneau, much of the Alaska-Gastineau mining equipment is being transformed into paper-pulp mills because the ore is running out and gold mining no longer pays. Anyone familiar with the talk in Montreal and Quebec, to say nothing of our own northern New York cities, knows that with the present price of print and book paper, the Texas oil fields have nothing on a pulp-wood country for wild rumors and easy money, so some of the Seattle paper talk may be discounted. But the material is there and the Pacific Coast ought to be a sufficient market even against the competition British Columbia will undoubtedly give, so engineers are justified in looking forward to a development in which they have a direct interest.

The Skagit River Project

In water-power development the city's Skagit River project is the most talked about. Seattle has had some recent unfortunate experiences in municipal ownership. During the war transit congestion became so great, especially around the shipyard district, as to be intolerable and the usual controversy between city and street-railway company resulted. Finally, for a variety of reasons, most of which are now enveloped in the customary haze of politics—the city bought the street railways. Now the citizens are paying 10c. a ride (two together for 15c. or four tokens for a quarter, with a prospect of only three for a quarter) and the administration is going through all the motions of a boy who, exploring the inside of a basket, has connected with the business end of a large and tenacious crab. In addition to this, the familiar behavior of the city's Cedar River reservoir, whose natural banks continue to leak despite the quarter million dollars spent in an attempt to seal them, is still fresh in the minds of the people.

These two experiences have been unfortunate because they will be used—are being used, in fact—to cast doubts on the city water-power scheme in the Skagit district, regardless of the real merits or defects of that project. Engineering arguments are used in technical discussions, of course, but the common people—who will in the end control the issue—are apt to be more influenced by generalities of municipal inefficiency,

whether those generalities be true or not, than by cold engineering and finance. So far the completed estimate of cost and profit of the Skagit enterprise has not been made public, but about $5,500,000 has been appropriated and the city is going right ahead on the scheme outlined by C. F. Uhden in *Engineering News-Record*, Nov. 18, p. 994. The opposition to the project is divided among those frankly against public ownership, either by conviction or association, and those who think that the construction of a new dam at the head of Cedar River lake—below the porous formation—and the construction of a tunnel to a power house near the present one, would generate enough power for all present needs. There is some prospect that the opponents will prove strong enough to cause the city to abandon the Skagit plan.

As to Seattle's port plans nothing but good can be said. The commission is far-sighted and well advised in a technical way. Thanks to its good business in the war years it is entirely self-supporting and with any fair prospect will continue to be so. The new Smith's Cove terminals with their wide piers and sheds, their effective railway tracks, high-capacity and quick-moving handling machines and busy fleet of trucks and trailers, are a revelation to one accustomed to the slow and backward methods of New York. The pity grows with every new and modern port seen that other cities have the equipment but New York gets the business. A firm belief in the ultimate triumph of right thinking is the only bulwark against pessimism in this phase of port engineering. Seattle, however, is alive to its possibilities. It realizes that mere transfer of freight does not make a port, but that industrial activity must be cultivated and to that end the Port Commission is working with a committee of business men to induce manufacturers to bring their factories into or near the port area. With financial conditions bettered in Japan, and Russia restored to activity, Seattle is the logical center for the northern oriental trade.

Road Bonds Defeated

In both Spokane and Seattle one hears a lot about the Carlyon bill, which proposed bonding the state for $30,000,000 for paved roads and which was defeated by a seven to four vote in November. Many engineers, the majority it seemed, were against it and some of the engineering societies, notably the A. A. E. chapter at Seattle and the Associated Engineers at Spokane, actively fought it. The difficulty seemed to be that the proposal was for a trunk-line system of paved roads—though some clauses of the bill seem to provide for a variation from the program, but by a cumbrous and possibly unworkable method. The opponents felt that Washington is more in need of radial highways from its smaller centers than for through lines and that it is more necessary to have some kind of passable highway—which means grading and subgrading—than to build first-class automobile roads. There was, too, much talk of the "cement trust" because the bill specifically favors concrete. It is significant, however, that in the West the recent highway bond proposals failed in those states where the new farmer-labor element is powerful. Unless they control the state, these people prefer the counties to run highway work.

Nothing is more evident in Seattle than the resentment against notoriety it achieved nearly two years ago when Ole Hanson "put down the rebillion." The

RUBY DAM SITE ON SKAGIT RIVER POWER PROJECT

publicity-loving Ole has now left the city and is getting more newspaper space writing despatches on the labor conditions abroad. Time softens most things, so perhaps reports today do not rightly mirror the conditions of the Seattle strike, but if what one hears now is true, there never was any danger of trouble in Seattle that could not have been readily allayed by less spectacular methods than were used. The skillful distribution of press matter swallowed whole by most of the newspapers in the country has left in the minds of the people at large an untrue idea of what Seattle overcame. Its citizens for the most part were right-thinking and quite capable of handling the violent tendencies of those among the laborers who made some gestures toward revolution.

Seattle is thoroughly American and her spirit of progress will not down. Because of the intensity of her war activity, the reaction, now that the war is over, is somewhat greater than in those cities that went more the even tenor of their ways from 1917 to 1919. But she is coming back.

Growth of American Merchant Marine

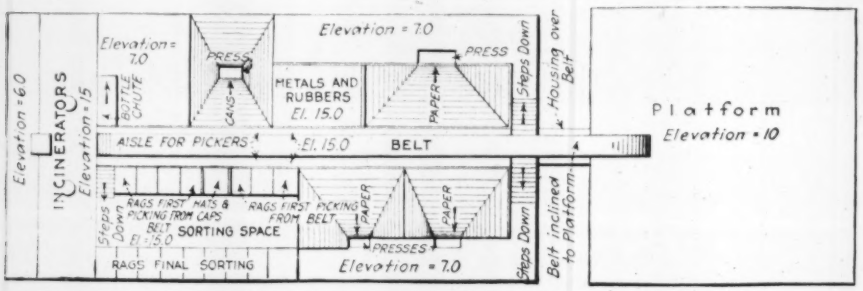
During September, for the first month since the armistice, according to returns of the Bureau of Navigation, Department of Commerce, the increase in the American seagoing merchant marine owned by American shipowners has exceeded the increase in the Government-owned ships built with appropriations by Congress. At the last session Congress, in the appropriation bills, changed the war policy and directed the Shipping Board to maintain itself by sales of ships and shore property without further appropriations. During September the fleet of seagoing ships of 500 gross tons or over of American shipowners rose to 1,829 of 4,625,324 gross tons, an increase during the month of 25 ships of 116,335 gross tons, while the Government-owned tonnage during the month increased only 20 ships of 88,855 gross tons, giving a Shipping Board total of 1,698 ships of 7,288,208 gross tons on Oct. 1. Since Jan. 1, 1920, however, the Government-owned tonnage has increased by 233 ships of 1,347,466 gross tons, while the commercial marine of American shipowners has increased only 129 ships of 536,926 gross tons.

Rubbish Collection and Disposal, District of Columbia

Work Taken Over From Contractor by District—Trash Sorted for Salable Materials; Tailings Burned—Salvage Pays 75 Per Cent of Cost of Collection and Disposal Operating Expenses

By Major F. S. Besson
Assistant to the Engineer Commissioner, District of Columbia

THE collection and disposal of the various classes of municipal refuse in the District of Columbia were for many years past accomplished only by contract. As the city grew larger and larger, more or less dissatisfaction developed with the contractual method, particularly as to the collections. On June 30, 1918, five separate contracts, each covering a distinct class of refuse, expired. Much difficulty was experienced in obtaining satisfactory new contracts. Emergency legislation was quickly obtained from Congress in order to take care of the garbage situation with District forces and efforts were made to obtain general Congressional enabling action authorizing the collection and disposal of all classes of city refuse as municipal functions.



PLAN OF TRASH OR RUBBISH SORTING AND SALVAGE PLANT, DISTRICT OF COLUMBIA

In 1919 the desired action was obtained and the Commissioners were authorized, "If in their opinion such action shall be to the best interests of the District of Columbia, to hereafter conduct any or all of the operations involved in the collection and disposal of city refuse of every kind as municipal functions: Provided, that any or all operations herein authorized to be conducted as municipal functions may be put into effect as such upon the expiration of any of the existing contracts for the collection and disposal of city refuse or upon the failure of any of the present contractors to properly perform the work covered by their contracts." Today the four major operations—street cleaning, collection and disposal of garbage, ashes, and trash [rubbish], are conducted by municipal forces, the last named having been taken over upon the failure of the contractor on Nov. 6, 1919.

For the trash collection and disposal contract, bids were received in 1918, as follows:

Period	Bid 1	Bid 2	Bid 3		Bid 4
July 1, 1918 to July 1, 1921	$45,000 per annum	$48,748 per annum	1st year 2nd year 3rd year	$54,000 35,400 15,000	$107,400 per annum

The amounts stipulated in the bids were those to be paid to the bidders by the District. Bid 4, $107,400 per annum, was submitted by the contractor who had been collecting and disposing of the trash since the year 1910 and had available the plant used in his former contracts. The lowest bid was accepted by the Commissioners. The amounts to be paid the contractor—$54,000 for the first year, $35,400 for the second, and $15,000 for the third—indicate that the bidder had expectations that the amounts would suffice for plant cost and maintenance, and that receipts from salvage would compensate for collection and disposal expenditures and allow sufficient balance for profit.

Due to a combination of mishaps during the summer and fall of 1919, the contractor was finally forced to report that he was unable to continue longer with his contract, and on Nov. 6, 1919, the Commissioners took over the plant and equipment of the contractor for operation under the terms of the contract as protected by the surety bond. The work will be done with municipal forces until the end of the contract period, July 1, 1921, at which time a final settlement will be made, and from then on, the District will have to make other arrangements for its own plant and equipment.

Now that the District, upon the failure of the contractor, has been operating the plant and equipment of the latter for a period of eight months, to July 1, the end of the fiscal year 1920, sufficient data are at hand to permit a correct analysis of the situation. The population of the District of Columbia is 437,500 and the land area 60 square miles. Trash is not collected from outlying thinly populated sections, nor from business houses nor large apartment houses. The area of the city from which collections are made totals 36 square miles, having an estimated population of 375,000, less those persons living in large apartment houses, etc., which it is estimated amounts to 45,000, so that collection is actually made from about 330,000 people. The average haul to the present disposal plant is three miles.

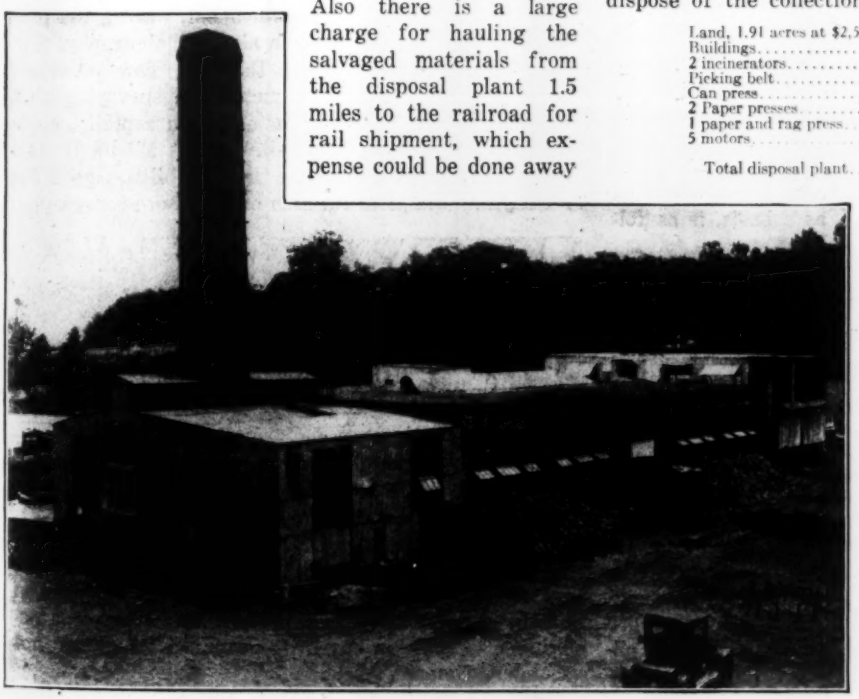
The disposal plant is in a building located at Mount Olivet Road and West Virginia Ave., N. E., where the trash is received, and sorted, the material with a salable value being salvaged, and the remainder burned, with the exception of a few large articles usually received, such as bed springs, furniture, large pots and cans. Strict enforcement of regulations governing the separation of refuse is maintained by the District and seldom or never does the householder put garbage or other forbidden refuse in with his trash. There are collected on an average 1,300 wagon loads of trash per month, each load averaging 11 cu.yd. This gives a total of 14,300 cu.yd. or a per capita collection of 0.043 cu.yd. per month based upon the 330,000 population from whom collections are made. The trash is collected in wagons with slat sides, the largest holding 14 cu.yd. and drawn by two horses. Two trucks are also used for special long distance collections. On the floor of

each wagon body and up the front is a chain and bar sling. Upon arrival at the disposal plant the front upper end of the sling is attached to a winch and the load dragged from the wagon. It is then run over a picking belt, and all that is not picked off as of value passes into the incinerators. The amount burned is but 7 per cent of the trash collected, and consists mostly of house sweepings, old flowers, pieces of wood, etc., but never of anything that in the burning would create a nuisance.

The material salvaged averages the following per month Paper, 1,000,000 lb.; books and magazines, 20,000 lb.; rags, 50,000 lb.; cans, 300,000 lb.; metals and rubbers, 4,600 lb.; 60,000 bottles; cullet (broken glass) 78,000 lb.

This salvage, in its loose mixed state, weighs approximately 120 lb. to the cubic yard and totals 12,600 cu.yd. The unsalable non-combustible large articles, such as bed springs, etc., which are not sent over the picking, belt weigh about 1,000 lb. per cubic yard and amount to 700 cu.yd. per month. The material burned amounts to 1,000 cu.yd., weighing 600 lb. per cubic yard. The ash remaining from the burning of this 1,000 cu.yd. amounts to 150 cu.yd. The material salvaged, nonsalable, and burned totals 14,300 cu.yd., which in the wagons, as collected, weighs 200 lb. per cubic yard.

There are certain expenses in connection with trash collection and disposal that would vary, due to the conditions that may exist in various cities. As to collections, much depends upon the service rendered the people. It is the aim of the District's City Refuse Division to take immediate remedial action on the least complaint telephoned or addressed to it at the District Building. Expenses of collection could be cut down materially if the average haul of three miles to the present plant could by a relocation be shortened, but there is difficulty in obtaining such a new location. Also there is a large charge for hauling the salvaged materials from the disposal plant 1.5 miles to the railroad for rail shipment, which expense could be done away with if a satisfactory location abutting a railroad could be obtained. Some cities attempt economy by passing the heat developed in the incinerators through boilers in order to generate steam for operating the equipment in the disposal plant. There is no such provision in the District plant. In fact it is considered that the calorific value of Washington's trash remaining after salvage operations is so small that no attempt should be made for such utilization.



EXTERIOR VIEW OF DISTRICT OF COLUMBIA TRASH DISPOSAL PLANT

(The unloading platform is at the far end, the picking belt and presses are in central or brick portion of the building and the incinerators at the left. The material piled against the building is broken glass awaiting shipment.)

Many additions and betterments have been made to the plant and equipment as originally taken over from the contractor in order to render proper service to the city. Equipment and plant necessary for satisfactory collection, under Washington conditions with an average haul of three miles to the disposal plant, consists of:

Land, ¼ acre at $2,500	$1,250
Stable and shops	2,000
37 horses at $250	9,250
25 wagons at $250	6,250
25 sets harness at $80	2,000
2 trucks	5,700
Sundry equipment	1,475
Total equipment and plant	$27,925

Yearly depreciation and taxes on the collection equipment and plant, as listed above, is estimated at 15 per cent or $4,189. Interest at 6 per cent amounts to $1,675, giving a total yearly charge of $5,864.

Collection operation and maintenance may be itemized per year as follows:

1 Foreman	$1,800
37 Men, drivers and collectors	42,800
4 Inspectors	5,760
7 Men, stable and shops	13,400
Forage	8,725
Wagon parts	750
Horse and harness maintenance	3,600
Truck maintenance	1,750
Miscellaneous supplies	750
Total collection operation and maintenance per year	$79,335

With additions and betterments to the contractor's disposal arrangements in order to properly salvage and dispose of the collections, the plant is as follows:

Land, 1.91 acres at $2,500	$4,775
Buildings	19,000
2 incinerators	7,000
Picking belt	2,026
Can press	4,000
2 Paper presses	6,000
1 paper and rag press	2,500
5 motors	2,000
Total disposal plant	$47,301

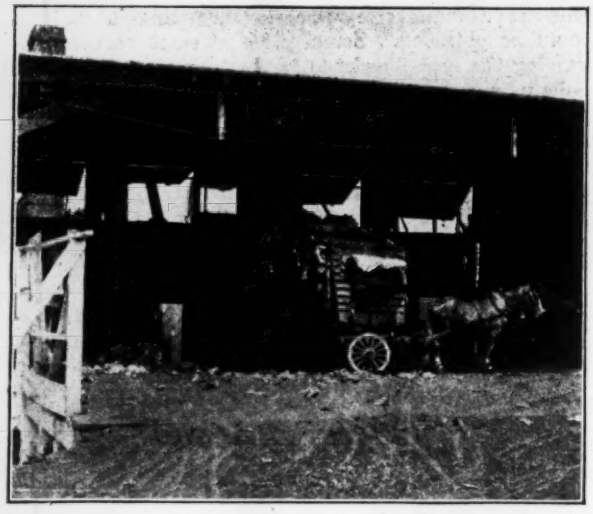
Taxes and yearly depreciation on the disposal plant are estimated at 7 per cent or $3,311. Interest at 8 per cent amounts to $2,838, giving a total yearly charge of $6,149.

Disposal operation and maintenance may be itemized per year as follows:

1 Foreman	$1,800
40 Women pickers	26,400
40 Men pickers and operators	51,100
Electrical power for operation	2,500
Baling, wire, and crates	1,500
General maintenance	9,070
Heat and ventilation	400
Hauling	3,120
Miscellaneous expenses	500
Total disposal operation and maintenance	$96,390

Overhead expenses for collection and disposal are:

1 Superintendent	$2,000
Administration	3,000
Salvage sales	3,500
Hauling to the railroad	8,000
Total overhead	$16,500



FOURTEEN-YARD RUBBISH WAGON, DISTRICT OF COLUMBIA

A winch in the rear of the shed pulls the load from the wagon.

Receipts from the sale of salvage vary widely from month to month due to great fluctuation in the market for materials of this nature. During the eight months' operation by the District the maximum and minimum prices received have been as shown below. For comparison there are also set forth the prices that were prevalent early in 1918 just prior to the submission of the contractor's bid.

Items	Maximum	Minimum	1918
Paper, cwt.	$1.70	$0.40	$0.20
Books and magazines, cwt.	1.80	.90	.75
Rags, lb.	.045	.022	.015
Cans, ton	6.75	4.50	1.75
Metals, rubber, etc., lb.	.07	.035	.05
Bottles, each	.009	.007	.008
Cullet (broken glass), ton	4.50	4.50	

For the eight months of District operation the receipts averaged $12,750 per month. For the month of July the receipts reached $22,000. Based upon the early 1918 prices the monthly receipts would total but $3,872.

A recapitulation covering a period of three years, the term of the contract, and using the average of the receipts during District operation as a basis, is as follows:

Items—Three Years	Credits	Debits
Contract payments	$104,400	
Collection, depreciation, etc.	.....	$17,592
Collection, operation	.....	238,005
Disposal, depreciation, etc.	.....	18,447
Disposal, operation	.....	289,170
Overhead	.....	49,500
Sale of salvage	459,000	.....
Total	$563,400	$612,714

The detailed data show that based on prices of equipment, materials and supplies, labor, and other expenses as current during the eight months' experience of the District, an average monthly receipt from salvage of $12,750 is not sufficient to show a profit. Though it is true that prices being received at the present moment for salvaged materials are such as would show a profit, it is considered that they are abnormally high. A fall in the market must be expected, and without a corresponding drop in labor and other operating expenses. Putting to one side capital expenses and contract payments, it may be stated that for the eight-month period in question, salvage sufficed to pay 75 per cent of the expenses of doing business, both collection and disposal. What proportion of the expense would be covered by salvage for the remainder of the three-year contractual period is largely a matter of guess work.

Surveying From the Air

Tests Indicate Great Possibilities in Expediting Mapping of Waterways and Interior Surveys

By Colonel E. Lester Jones
Director, U. S. Coast and Geodetic Survey, Washington, D. C.

THE great possibilities of airplane photography in connection with the water and land work of the U. S. Coast and Geodetic Survey are looming up as a potential factor in expediting the mapping of our waterways and interior surveys. This important subject has been the object of careful study and experiments by officers of the survey, in collaboration with the other branches of the government, during the past year and the rapid advance in aërial photography, first seriously undertaken during the war, now promises, with proper development, a method of surveying that will probably far exceed expectations in rapidity, economy and minuteness of detail. Stress should be laid on the fact that not only are the possibilities good for an early and complete revision of our shore topography,

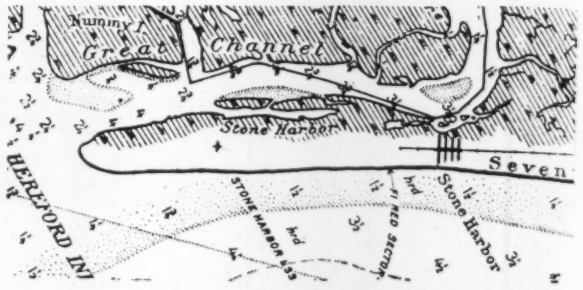


FIG. 1. SECTION OF CHART SHOWING STONE HARBOR, N. J., AS SURVEYED IN 1899

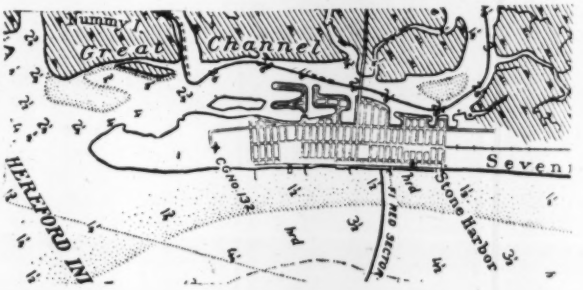


FIG. 2. SECTION OF CHART SHOWN IN FIG. 1 AS REVISED FROM AIRPLANE PHOTOGRAPH MADE IN MARCH, 1920

but the opportunities that present themselves for assisting materially in our hydrographic work should not be underestimated.

With the necessary facilities and co-operation supplied by the Army and Navy Aviation Corps to the

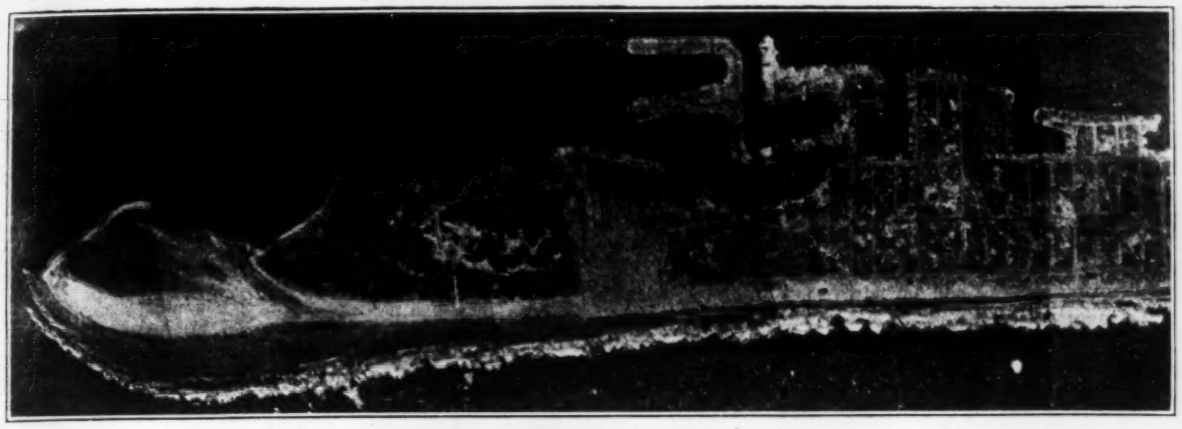


FIG. 3. MOSAIC OF STONE HARBOR, N. J., FROM PHOTOS BY ARMY AIR SERVICE
K-1—Mapping camera used: altitude 10,000 ft., approximately. Scale of original 1:10,000. Data reduced directly from this mosaic to scale of chart by means of pantograph.

Coast and Geodetic Survey, experience has already proved the value of aërial photography over the old method of surveying in revision surveys of our coast lines. This work, so far, is divided into two branches: (1) Aërial photography and (2) aërial photo-hydrography. The results are shown in the following recent practical demonstrations.

Aerial Photo-Topography

In July, 1919, experiments were made at Atlantic City, N. J., to ascertain the adaptability of airplane photographs for use in topographic mapping. The area in the vicinity of Atlantic City was chosen as it is characteristic of so much of the coastal plain territory of the Atlantic coast. This project was essentially experimental in character, but developed into one of practical value, as the photographs are being used in a revision of the charts of the New Jersey coast.

The work was done in co-operation with the Air Services of the Army and Navy. Both land and seaplanes were used, and in addition several photographs were made from a dirigible. Three types of mapping cameras were tried out, the "L" type, K-1 and Trilens. An officer of the survey kept in close touch with the work and furnished the ground control, constructing special targets in some cases.

A mosaic was constructed by members of the Air Service of the Army, using the photographs made with the K-1 mapping camera. These were taken at an altitude of 7,000 ft., using a lens of 10-in. focal length, with a resulting scale of about 1:8,000. A rough control scheme was first laid out and the mosaic constructed over it.

The most important point brought out from the study of the results of the work at Atlantic City was the possibilities in revision work, especially along those sections of the Atlantic coast where the shoreline is subject to frequent changes owing to the action of the sea.

Aerial Photo-Hydrography

At the same time that the experiments at Atlantic City were being made, at Key West, Fla., photographs were taken by the Naval Air Service to determine the possible use of aërial photographs in connection with hydrographic surveys. The primary object in view was the elimination of wire-drag work, especially in the clear waters of the Florida coast. An attempt was made to photograph small coral heads and pinnacle rocks, as it is the existence of these needle-like dangers to navigation that requires the use of the wire-drag. Photographs were made at altitudes of from 200 ft. up to 4,000 ft. and under various light conditions.

The problem of control was solved by including in each photograph two vessels of the survey. The photographs could not be corrected for tilt with only two known points as a base, but the control, as furnished by the positions of the two vessels, was found to be sufficient for experiments.

A well-surveyed area near Key West was chosen, and the vessels proceeded on parallel courses over this area at full speed, the plane flying forth and back above the course. The courses and position of the vessels were recorded as in ordinary sounding work. The photographer in the plane recorded the exact time that each exposure was made, with other data such as altitude, exposure, plate, filter, etc. Each photograph was later oriented by plotting the positions of the vessels on the chart at the instant the exposure was made.

Conclusions

These experiments proved conclusively that photographs from the air, using present-day equipment, are of little practical value to the hydrographer. When any of the underwater features did appear in the photographs, contrast in color was the most prominent, with no indication as to whether the contrast indicated shoal or deep water. Vari-colored bottom of uniform depth appears in the photograph as apparent difference in depth. Many charted shoals are not indicated in the photographs while adjacent ones show clearly. Taken altogether, the results are so uncertain that the chances of eliminating field work in hydrography are remote. Developments in the art of photography may change this viewpoint.

In March, 1920, the Army Air Service photographed the coast line of New Jersey from Cape May to Seabright. A single flight was made using the K-1 camera. The plane flew at an altitude of 10,000 ft. and under very good air conditions. The camera was mounted in gimbals, with a lead weight at the lowest point to assist in maintaining the optical axis of camera in a vertical position. Level bubbles aided in keeping the

camera in the proper position. This is the most satisfactory way to suspend the camera and control its verticality. The photographs are being used for a revision of the charts of the coast of New Jersey. The individual photographs are 18 x 24 cm. in size and the approximate scale is 1:10,000. The photographs are mounted in strip mosaics for convenience sake, not over 4-ft. in length. The length is generally determined by the position of control points. This composite photograph is compared with the topographic sheet of the same area and control points identified. The scale of the photographic mosaic is determined, and by means of the pantograph the data are reduced to the scale of the chart and transferred from the photographs to tracing paper.

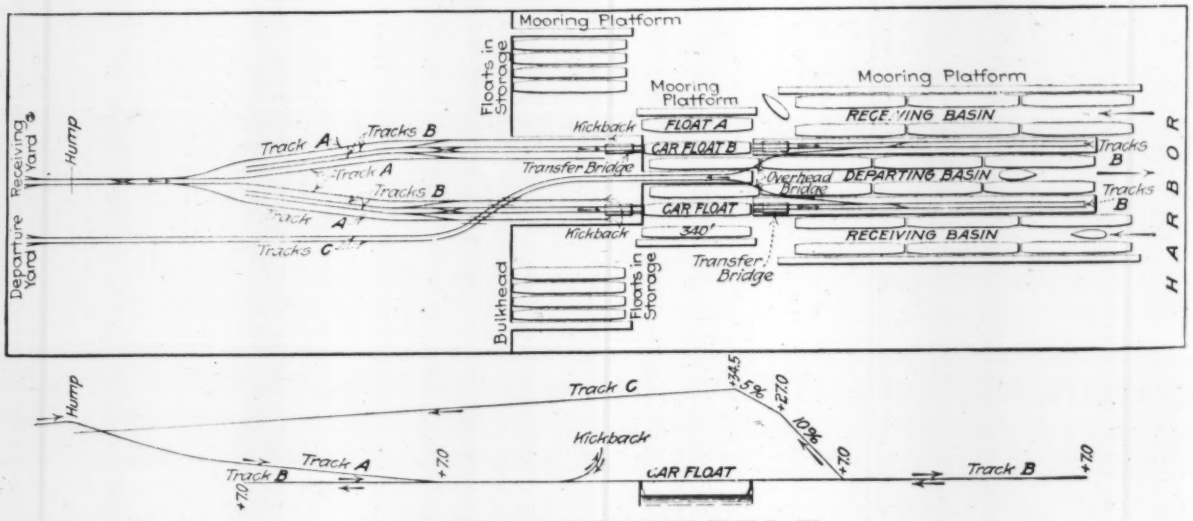
The photographing of this 120 miles of coast line took less than 2 hr. time in an airplane. The development of the films and printing took two days' time of one man. Two rolls of film were used, a total of 183 photographs. The work of interpreting the photographs, assembling mosaics, comparison with topographic sheet and reduction to the scale of the chart of the outside shore line required 15 days of office work by one engineer.

Proposed Method for Handling Car-Float Transfer Movement

By J. Jervis Vail
Assistant Engineer of Construction, Pennsylvania R.R., Rahway, N. J.

DEPARTURE from present methods of loading and unloading car floats is suggested in the accompanying drawing, the purpose of which is to attain something of the economy and speed reached at coal car dumping layouts and to moor floats so that they can be moved in and out of the bridges quickly without the capacity of each track on the floats. From the hump the cars run down by gravity from one of the four tracks marked *A* to the kickback, which reverses their direction and throws them back on one of the tracks marked *B*. On this track a small electric locomotive, geared to a rack between the rails, will couple up to the train and push the cars onto the float. At the same time a similar locomotive on the outshore end of track *B* will pull off the cars arriving on the float push them up the steep grade at the outshore end of one of the two tracks marked *C*, and drop them over the hump so that they will run by gravity to be classified in the departure yard.

Cars will be pushed onto both tracks of the float at one time and would be unloaded from both tracks at the same time in order to eliminate strain on the bridge and float due to unbalanced loading. The movement of arriving floats will be into either of the two receiving basins. Float *A* has been moved from the receiving basin and is tied up to the mooring platform ready to go into the bridge berth. Float *B* is at the bridges ready to be unloaded and then loaded. From here it will go into the departing basin, where towboats make fast to the floats for convoy. Floats requiring special movements can enter the bridges through the inshore openings and be taken out the same way. The floats should be of standard length, or otherwise it would be necessary to move them longitudinally in the slip after unloading before cars could be loaded at the opposite end. Floats in the basins would be moved by electric winches without the use of a towboat.



CAR-FLOAT LAYOUT EMBODIES KICK-BACK

a towboat. The method contemplates employing the kickback track and the principle of loading cars at one end of a float and unloading them at the other, originated by A. T. Luehman, assistant to engineer maintenance-of-way Pennsylvania R.R.

Cars to be loaded onto the floats, represented in the drawing, will be pushed over the hump from the receiving yard and cut off in bands of eight, equivalent to

Asphalt Pavement Laid at Fast Rate

What is believed to be a record hard to equal in laying asphalt pavement was recently accomplished by city forces working under the supervision of J. H. Johnson, superintendent of highways, Providence, R. I. According to Mr. Johnson twelve men laid a 2-in. asphalt top on a 4-in. sand-filled, compacted stone base penetrated with 2½ gal. of asphalt per square yard, on a Providence street 2,000 ft. long and 24 ft. wide, the entire job from subsoil to surface being done in 18 successive working days. The street so surfaced is Alverson Ave., from Plainfield to Hartford Aves.

Relative Service Value of Pavement Types

Paper (Slightly Condensed) Read by A. R. Hirst, State Highway Engineer of Wisconsin, at Annual Meeting of American Association of State Highway Officials, Washington, D. C., Dec. 13-16

IF, IN a discussion of the relative service value of different types of rural pavements, any one expects specific rules and well-buttressed conclusions, he is doomed to disappointment. It is my opinion that nothing of the kind is justified from the information now available. The term "relative service value" is, itself, open to various interpretations. It might be held to cover only the potential power of a pavement to bear traffic of various amounts regardless of cost or economics, or it might be held to include the two latter factors. The author prefers to include the latter, and hopes that he will be excused of a possible overlap due to this interpretation.

Among the characteristics usually listed as important in determining the service value of pavements, are: (1) Freedom from dust; (2) appearance; (3) character of foothold; (4) ability to clean; (5) freedom from sanitary objection; (6) character as regards noise; (7) freedom from slipperiness, and (8) low tractive resistance.

Almost without exception the characteristics cited above are among the least important of the matters to be considered in determining the service value of rural pavements. The predominant factor in determining the relative service value of pavements is whether they serve the traffic effectively and cheaply. It may be given as a truism that given effective construction and proper width, almost any one of a dozen different pavements will give good service. The question to be determined by the highway engineer is whether they have given, or will give, good service cheaply.

Traffic

Highway traffic is, of course, the first factor to be seriously considered in connection with pavement economics. Traffic is the thing which makes highway surfacings worth while, and the thing which wears them out. Its amount and its characteristics are important and should always be taken into account.

We are going to shock a good many of our more theoretical brethren by saying that a preliminary traffic census is absolutely valueless in helping to determine the type of surfacing to be used. An inspection of the location of a road on the map, a knowledge of its relation to other roads and to the general highway system, and to business centers; together with a consideration of the business tributary to it and probably to be tributary to it, will tell a highway engineer, who knows his business, whether the construction in question should be first, second, or third class. The traffic on a road last year or last month has absolutely no value in this connection, because when a highway becomes a part of a superior highway system, or when one highway is paved with a surface superior to that on the adjacent and competing highways, traffic is so concentrated on that highway that what has been is no indication of what will be.

Any assumption of what traffic will be is merely an assumption and the presence on a certain past day of one hundred automobiles, ten trucks, eight farmers or their wives in single buggies, and three babies in their perambulators, has really no bearing on the future situation.

Traffic counts have value only as serving to give accurate information as to the constantly occurring changes in traffic conditions, and in determining the relative cost of service per unit given by various pavements. The unit cost per ton of carrying traffic is the important consideration and, unfortunately, we have little or no information on this point.

The fact that this type of pavement was maintained for so much per annum and that type for so much per annum means little, unless we know the amount and weight of the traffic served and that it was served adequately. Even then the information would not be conclusive, because the pavement which gave this unit cost under the prevailing soil and climatic conditions might give an entirely different unit cost under different soil and climatic conditions. We have been too prone to assume from the results of experience with a limited number of stretches of a certain type of pavement, built and maintained under certain conditions, that the same results will ensue from the use of the same pavement wherever it may be built. This is not the case. Climatic, soil, and rainfall conditions must be considered as well as traffic and general performance.

Weight of Traffic

Among the important circumstances affecting the service of pavements is the weight of the traffic which the pavement bears.

American highway engineers have been condemned by the unthinking for having built roads which have not stood up under the intense motor traffic of recent years. It would be just as sensible to condemn a railroad engineering department for the failure of railroad bridges under engines

Important Points in Mr. Hirst's Discussion

1. The prime factor in determining the relative service value of highways is whether they serve traffic effectively and inexpensively.

2. Preliminary traffic censuses are valueless as aids in pavement type selection.

3. Traffic counts have value only in giving information upon traffic changes, and operation costs over varying pavement surfaces.

4. What has been is no indication of what will be.

5. States must adopt uniform loads to be borne by roads of varying classes of importance.

6. All highways cannot be made 15-ton highways every day in the year.

7. Expressed in terms of real service value, type means little unless selection of it is supplemented by proper design and layout.

8. The road problem is not to build a few boulevards but a transportation system.

9. We have thought too little about the basic function of highways—the offering of facilities for travel.

10. A striking feature of highway construction, reconstruction and maintenance has been an almost total disregard of comfort, convenience and economy of operation in the interests of the traveling public.

11. The one permanent thing about road work is proper grading on correct locations.

12. The highway user knows little about pavement economics; but he does know where and when he broke the last spring.

13. We have used too much mathematics and too little common sense.

14. Car owners demand service and service they must be given.

15. Maintenance is the keystone of the entire structure of pavement service.

weighing 200 tons, when the bridges were designed for engines weighing 20 tons. Before new and heavier loads are allowed on any length of railroad all parts of the construction are examined and, if necessary, strengthened or rebuilt before the new traffic is allowed to pass over them. There has been nothing of this in highway practice. Loads almost without limit have been placed upon highways designed for conditions existing and anticipated a decade ago, and condemnation has resulted when the inevitable failure of the road structure ensued.

It would seem that it would be clear to even the feeblest-minded that it is not going to be possible for the designers of vehicles using highways to turn loose upon highways any behemoth their ingenuity may design at any time they feel like doing so. It isn't possible to reconstruct the highway system of America every few months, or even every few years.

It is imperative that the several states adopt uniform standards for the loads to be borne by roads of the different classes of importance. It is going to be difficult to do this, because when a motor vehicle is once started toward its destination its operator will wish it to carry its full load for the whole trip, but it seems inevitable that we must classify highways as to the allowable loads upon them, and that traffic on highways must be made to conform to these loads. All roads cannot be made 15-ton roads every day in the year.

It is undoubtedly going to be possible for the states between their congested centers and on certain through highways to finance ultimately the construction of roads which will every day in the year permit loads of twelve to fifteen tons or, if the economics of transportation really justify it, even more. But just as certainly it is going to be impossible for the states to finance the construction of any great percentage of their roads so that they will stand such loads every day in the year, and I believe that on the secondary roads and roads of the lower classes, much lower load limits must be insisted upon, especially at certain seasons.

Continuous Travelability

One of the intangible factors in the service value of types of pavement is the factor of continuous travelability. It goes without saying that given two pavements of equal annual cost, one of which is out of service for several days each year and probably for two or three months at several times during the assumed pavement life, the other one allowing the passage of traffic during its life with practically no inconvenience and no detouring, the choice would immediately fall upon the one which gives the superior travelability. Furthermore, if the maintenance of one type demands annually, semi-annually or periodically, the application of such materials that traffic cannot be accommodated during the application or, if accommodated, is subject to possibility of accident from slipperiness and to defacement of vehicles and clothes, it is a serious impairment of the service value of the pavement.

One of the strikingly characteristic things about American highway practice has been the almost total disregard for the comfort, convenience, and economy of the traveling public during construction, maintenance and reconstruction. A public-be-damned policy has been quite generaly practiced. The traveling public has been considered as an interloper, with no possible business save to pay the bills.

The economic loss to traffic through detouring has been tremendous. For example: A road carrying a traffic of 1,000 vehicles a day is closed for a length of five miles due to construction or reconstruction, for a period of four months, the detour being eight miles in length, a loss to traffic of three miles. The total traffic loss is therefore 360,000 miles, which, at 12c. a mile, is $43,200, a figure which may well have a material bearing upon the type of pavement which one should select. Similarly derived figures will illustrate the importance of speed in construction and reconstruction and demonstrates that it is usually worth paying for.

We have been too prone to select types of pavement on the say-so of others without very material consideration of the matter of cost. The minute we commence to discuss the relative cost of pavements we are thrown into the ocean of economic discussion at a point far beyond our depths.

We are immediately brought in contact with the question: "Should an engineer in weighing the merits of two or more types of pavement consider the factor of interest on the original investment?" Many good authorities say "Yes"; many good authorities say "No." I do not pretend to be good authority, but I am sure that the answer is "Yes." The statement that the value of the pavement in increased comfort, convenience, saving in hauling, saving in gasoline, tires, etc., far offsets the interest on the investment, sounds very nice; but what is one going to do about it when one is considering two types of pavement, both of which do all of these things, but the costs of which are very dissimilar?

In addition to this difficulty with the basic economics of the situation, we have the further trouble that in comparing the unit annual cost of various pavements, we must make assumptions as to the lives of pavements, and we have little or no information on which to base these assumptions.

It might be of some value to cite the factors entering into an economic comparison and to show just how far one can get in his figuring:

1. *First cost of the pavement.*—This is readily determinable within the limits of estimating and causes no trouble.

2. *The interest charge on the pavement investment.*—This charge should be compounded annually and is, of course, readily determinable.

3. *The annual cost of maintenance of the pavement.*—This is only moderately guessable because no one can tell what the cost of the materials and labor entering into repairs will be next year or in succeeding years. Furthermore, no one can guess what unexpected development of traffic may entirely upset the conditions under which the surface exists.

4. *Interest on the maintenance cost.*—This should be added to the cost of the pavement and should be compounded annually.

5. *The assumption of the life of the pavement before total reconstruction is necessary* —Again we are in the field of theory, because the life of the pavement depends upon the traffic which it will carry through a series of years. Furthermore, on many of the pavements which are now being widely used, enough information is not available to determine what the life may be, and even on some of the older types of pavement, built under supposed to be standard and fool-proof specifications, a variation in life of several hundred per cent has been noted.

Total Pavement Cost

The summation of items 1, 2, 3 and 4, divided by the number of years of expected life of the pavement gives the annual cost to the public of the pavement so far as the mere outlay of money is concerned.

Before the division by the number of years of expected life is made, however, there should be subtracted from the total cost the value of the old pavement for use in the new pavement. Here again we are in the realms of guesswork. Assuming that a certain type of pavement can be preserved for twenty years and will then need resurfacing or replacement by another type, we are making a grave assumption if we value the base at anything very material, because the change in traffic on rural highways is so rapid that it is very hard for one to say that the alignment, grade, culverts or structures that we are building today, or the widths that we are using, will be of any great value twenty years from now.

At the end of this series of guesses and assumptions upon assumptions, one will have some basis, better than no basis, for comparing the annual cost of the types under consideration.

Highway engineers have been designing pavements of too narrow widths, and have multiplied their troubles of maintenance by confining traffic to one or two very restricted lines. *The conduct of all pavements, especially of the so-called inferior pavements, such as waterbound macadams, gravels, and the lesser non-rigid types, is good or bad in almost direct proportion to whether they have been built wide or narrow.*

I am not going to develop this thought in detail, but I believe that highway engineers will find that, if they will design the so-called non-rigid roads wider and flatter much of the trouble incident to the present use of these structures will be avoided.

A supposed-to-be two-track concrete or other rigid surface road built 14, 15 or even 16 ft. wide on a main-traveled highway has its service value greatly reduced by its inadequate width because it breeds disastrous accidents and causes worry at all times. The shoulder maintenance is also a constant source of worry and grave expense if traffic is at all heavy. Furthermore, the concentration of traffic and the crowding to the extreme edges brought about by such widths reduces the effective life of the pavement very materially. It is our opinion that even the rigid types of pavement must provide for a moderate distribution of traffic if they are to hold. The minimum two-track highway is 18 ft., and 20 ft. is better on principal highways. If municipalities cannot finance these widths they had better build part of their lengths of a cheaper type, pending the securing of more money. Plastic or viscous surfaces of all kinds must have width to allow for traffic distribution, especially if built in a climate of wide total temperature variation. On these types especially traffic must be distributed so that it will heal its own marks and not deepen them in heated periods.

On primary highways, unless convenient detours are available, all pavements which from their nature require frequent surface attention embarrassing to traffic should be constructed wide enough so that they can be maintained and repaired one half at a time.

Design and Service Value

The service value of any kind of pavement depends largely upon proper design. It is not only necessary that the pavement be well drained, that it be built of the right depth and width, but the materials in it must be properly sized and prepared. For instance: A gravel road built of uncrushed and unscreened gravel, varying in size from sand to cobble stones as large as one's head, has practically no service value today, because it is impossible to maintain such a road so as to give satisfactory service. On the other hand, a road built of the same width and depth and of the same gravel properly crushed and sized may give most economical service. In Wisconsin we have reached the point where we don't want any gravel within 4 in. of the surface larger than 1 in. and we prefer to have no gravel in the whole structure larger than 1 in.

The service value of any highway may be seriously impaired by the use of sharp and dangerous curves, poor alignment, narrow bridges and culverts, heavy grades, and unnecessary lengths. *A well laid out highway of inferior surface will many times give better service value than a poorly located highway built with the best surface. Expressed in terms of real service value, type means little unless the selection of a proper type is supplemented by proper design and proper layout.*

We believe that maintenance is the keystone of the entire structure of pavement service. Proper selection, design, layout and construction must be immediately followed by intense maintenance if the potential service value of a pavement is to be secured. *Any discussion of the service value of any type of pavement has no basis unless the assumption is made that good maintenance protects the pavement and gives it a chance to serve.* Types seemingly unsuited for the traffic may, when properly maintained, give better service than a much more suitable surface left to care for itself.

Traffic Distribution

I am going to interject just a word or two on the important topic of traffic distribution. We are prone to view future traffic development entirely upon the assumption that one road between two points is going to serve all traffic between these points for all time. I doubt that this is true. Alternate routes will be developed and traffic thus distributed. This will be good from many standpoints. It will prevent traffic congestion, allow the use of cheaper surfacings, accommodate more local traffic, provide a choice of routes, and allow for repairs and reconstruction without closing all available routes. *The road problem of America is not to build a few boulevards; it is to build, maintain, and keep always open, a transportation system.*

Wisconsin has now maintained her 5,000-mile state trunk highway system for three years, and over 2,000 additional miles for one year, and we have gained some idea of the maintenance cost of various types. The condition of the several sections varied so much when they were taken over, and the relative service given is so dissimilar that very little can be determined from an inspection of our figures on maintenance costs.

In 1919 the average cost of maintenance per mile of all types, surfaced and unsurfaced, was $254. The average cost of maintenance per mile by types (taken from a large number of sections) was as follows: Earth, $223; gravel, $212; waterbound macadam, $516; penetration macadam, $252; concrete, $337. Qualifying these figures, it would be only fair to say that the earthroad maintenance included much heavy blade grader reconstruction; that the waterbound macadams had been allowed to get badly out of repair; and that all but $62 of the $337 for concrete was used in shoulder and ditch maintenance and in applying gravel to shoulders on the too narrow 16-ft. surfaces.

As indicating the possible value of well maintained gravel roads we segregated nine very satisfactory patrol sections of gravel road and tabulated at least two separate traffic counts on each. The average count on these roads was 1,059 automobiles, 44 trucks, 21 motorcycles and 48 horse-drawn vehicles per day. Weight was not taken. No effort was made to get maximum day counts. The roads in question gave excellent service every day in the year. The average cost per mile per section of maintaining these nine patrol sections was $263. These roads were not surface treated.

Our experience with gravel roads indicates that when well built of adequate widths with fine crushed materials and well maintained, their traffic limit is far higher than has been hitherto assumed.

Traffic Problem

In considering the relative service value of pavements one cannot disregard the matter of expediency. There are, when considering a road problem and when determining an economical type to be used, always these factors to be considered: (1) The expected traffic; (2) the materials locally available; (3) the funds available; (4) the whole financial, traffic and highway situation in the unit of government to be served. This last factor is far the most important one, and too often has been totally disregarded.

We have thought too little about the basic function of highways which is of course to offer facilities for travel. We have been too prone to concentrate upon a specific length of highway and economic design, rather than to concern ourselves with the more important traffic situation in the unit of government in which we operate. We have been content to design and build a few miles of highway each year and to look forward with the hope that some day the contemplated system would be completed and traffic would be free to come and go as it pleased. We have closed our eyes to the fact that in the meantime we had on our hands scores or hundreds or thousands of miles of highways which are difficult of travel at all times and impassable at some.

Far more important than the mere selection of a truly economical type of construction for assumed conditions on a specific highway is the importance of determining what program of improvement will be of the most benefit to the traffic in a designated area.

The schoolman has so obsessed us with his ideas of so-called true economics in pavement construction that we have been inclined to lose sight of the much more important economics of the traffic situation as it exists and as it may be expected to develop. We have been so impressed with the importance of economic design of specific stretches that many of us have entirely lost sight of economic design for

a traffic situation. If unlimited funds, labor, and materials were always available it might be possible that the schoolman is right, and that we should never build anything but the truly economical surface, but there is always a limit to the funds which can be made available, or which can be expended in a specific term of years. The true economics of pavement design is to find the solution which gives the least cost, not only of the construction and maintenance of the pavement, but in the carrying of traffic in the designated area within the designed period.

As an illustration of this point, Normal County has 200 miles of road of the most importance, 200 miles of secondary highways, important from the county standpoint, and 400 miles of strictly local highways, cared for by the local units of government. Outside of the funds which can be made available for the general maintenance of these 800 miles, it can be foreseen that in the next five years the total funds available for highway improvement in Normal County will be $4,000,000. Of the 200 miles of first class highway, 50 miles have been surfaced in the past and are still maintainable, and 150 miles are earth, without hope of redemption. Of the 200 miles of less importance, 20 miles have been surfaced and 180 miles are earth. Of the 400 miles of local roads, all are earth. Traffic conditions are at present intolerable in the county. Each rain means a blockade; each spring and rainy season an absolute cessation of traffic except by team, and that traffic is almost blocked.

The $4,000,000 available in the five years will, it is estimated, build 100 miles of the schoolman's economically correct highway. If the public officials determine to build this type of highway, at the end of five years there will be 230 miles of the first and second class highways (over 50 per cent of the whole) still unsurfaced. Isn't it plain that this answer cannot be correct, regardless of the so-called economics of the specific instance? Isn't it plain that the public body controlling the money should consider most carefully the whole situation, and spend the $4,000,000 in an effort to make passable at least all of the 400 miles of principal highways?

Economic Construction

The schoolman will say that some of the money is wasted because a portion of the types built are not going to exist for twenty or fifty years, but the economic waste incident to the use of uneconomic types is not a marker to the economic waste incident to the continued use of a largely unimproved system of highways. In other words, the loss to traffic by the prolongation of such a situation is usually infinitely more than the loss to the public due to the construction and maintenance of types requiring renewal after a term of years.

Carried to a logical conclusion, some one will say, *this plan means building largely temporary surfacings, and later on building again. It does! And why not, if that is the true economic solution?* Most of our railroads have been rebuilt more than once. I believe we must proceed along exactly similar lines. First accommodate traffic, building to the money which can be made available, expecting that after the traffic is gotten through and the adjacent territory reaches fuller development, the necessary betterments will follow.

There has been considerable criticism to the effect that a large proportion of the Federal-aid construction is going into low-class structures and that therefore the funds are being wasted. Ninety per cent of these critics never designed or built a highway, nor have they ever tackled a legislative body to get it to finance one.

In Wisconsin about 19 per cent of our total mileage of Federal-aid construction will be concrete, 2 per cent macadam, 42 per cent gravel, and 37 per cent earth, with modifying surfacings to make them passable. Expressed in terms of money, about 40 per cent will go into concrete, the remainder into grading and other types. Every project solved a traffic problem and freed a community from impassability or danger. No one can tell me nor can he tell the communities in which the work was done, that the money was wasted. Our critics themselves, if faced with the same problems, would have come to the same decisions.

We hope that all states will hold to safe ground and serve traffic now. Deviation from this policy is more apt to waste money than is adherence to it. Probably more federal and state money has been wasted in prematurely building unnecessarily expensive types of surfacing than has been wasted in grading and building the lesser surfacings. *After all, the one thing that is permanent about road work—the one thing that cannot be done too well or too soon, is proper grading on correct locations.* Those states that are feeling their way by doing much of this kind of work at places where traffic has been previously stalled by grades or drainage conditions are not wasting money—they are investing it with profit.

It may be inferred from this paper that it would take the brain of a Demosthenes, the genius of an Edison, and the engineering skill of a demigod to determine what pavements should be built, given a condition, these theories, and a sum of money. Such is not the case. In four cases out of five a decision can be readily and quickly made when all pertinent facts and circumstances are known. It takes, largely, common sense and business judgment sufficient to grasp relative values. It is a matter of experience and judgment, rather than of the slide rule and arithmetic. We have used too much higher mathematics and too little common sense. We have sought to set ourselves upon a pedestal of economic perfection and have closed our eyes to many of the surrounding circumstances, until many of us cannot recognize a real economic fact when we meet it. The people are commencing to demand results rather than higher economics. *They don't know much about pavement economics or relative economy of types, but they do know when and where they were stuck in the mud and where they broke that last spring.*

Service Must Be Given

There are too many hundreds of millions of dollars invested in means of motor transportation, and too much pleasure, comfort, convenience, economy and time saving depends upon their immediate, economical and safe use for us to trifle with the facts as they exist. The owners of these vehicles demand service. They must be given it. This despite the fact that many manufacturers of motor vehicles persist in pursuing the *ignis fatuus* of highly centralized highway systems and of highly concentrated construction. Automobiles and motor trucks are owned on almost every square mile of territory and use every main highway. They cannot serve or attain complete efficiency unless they can get through everywhere—now! Why their producers should deliberately work to limit their use offers to me an enigma impossible of solution.

It could be nice indeed if we could serve traffic always and immediately with the ultimate, but it is mechanically impossible. Until we can so serve it we must meet the situation which exists and get the best result we can with the means at hand.

Let's not worry so much about our predecessors or our successors; let's do our best for our contemporaries. Service value doesn't necessarily mean the ideal for the next decade, it may better mean service value right now.

A county or state highway department should not exist merely to design and build a few miles of highway and a few culverts and bridges. It should exist to give transportation service to its clients. We should be purveyors of transportation to his majesty, the American people. Traffic must be served!

Ex-Service Men in Engineering Schools

Of the 1,949 disabled ex-service men who are taking engineering courses under the vocational education statute, 291 are pursuing civil engineering courses. In addition, 68 are taking architectural engineering. This instruction is being given under the auspices of the Federal Board for Vocational Education. The work in civil engineering is divided among seventy-eight schools, of which nine are in New England, twenty-one in the East, ten in the South, eighteen in the Middle West and twenty in the West.

Salaries and Qualifications for Manitoba Engineers

Classification Based on Society Membership Grades —Duties, Requirements and Salary for Each Grade Specified

DIRECT action toward improving the recognition and remuneration of the engineer has been taken by the Manitoba branch of the Engineering Institute of Canada in adopting salary schedules, urging employers to follow these schedules and requesting its members to pledge themselves not to accept positions at salaries below the schedule rates. The following particulars, amplifying the news note which appeared in *Engineering News-Record* Nov. 18, p. 1013, are taken from the report of the salary committee; it will be understood that the schedules relate only to engineers within the province of Manitoba.

CLASSIFICATION

The classification of engineers was based on four factors: (1) Education; (2) experience and ability; (3) responsibility to be borne; (4) character and scope of work. The first three are sufficient to determine the class and the fourth determines the salary within that class. A general classification was based upon the grading of the membership of the Institute, since it would be an extension of an existing system and would define accurately the qualifications for the different grades of membership. Further, engineering activities were subdivided as follows: (1) Railway; (2) public works and utilities; (3) municipal; (4) industrial. The main classification is shown in Table I.

TABLE I. CLASSIFICATION FOR ENGINEERS IN MANITOBA

	Institute Membership	Grades and Basic Minimum Monthly Salaries
1. Professional engineers.....	Member	A, $600; B, $450
	Associate member	C, $350; D, $275
2. Sub-professional service.....	Junior	E, $175
3. Non-professional service...	Student	F, $200; G, $100; H, $90

DUTIES AND QUALIFICATIONS

Definitions of the several grades as drafted in the report are given herewith, somewhat condensed:

1. Professional Engineers.—Grade A: Chief administrative charge of a technical organization or a main division thereof; to determine general policies; to have final responsibility for reports, estimates, designs, and specifications, and for construction, maintenance or operation; to have full charge of valuation proceedings; to conduct or direct the most comprehensive lines of engineering research.

The qualifications are along lines of work similar to those of the position to be occupied, and of at least twelve years' duration, of which at least four years shall have been spent in duties of engineer, or their equivalent, and at least five years in responsible charge of important work or projects. Fundamental training must be equivalent to that represented by a professional degree granted upon the completion of a standard course of engineering instruction in an institution of recognized standing, or, in absence of such degree, at least four years of additional experience. The completion of each full year of such standard course is considered equivalent to one year of additional experience.

Grade B: Under general administrative direction to have responsible charge of and to initiate and determine policies for a major subdivision of an organization; to prepare reports, estimates, designs, specifications and valuation studies; to have immediate charge of construction, maintenance or operation of works of major importance; to conduct or direct major lines of engineering research; or to furnish for executive action advice on engineering works, projects or policies.

The qualifications cover active professional practice or executive charge of work for at least eight years, of a character to demonstrate a high degree of initiative and of ability in administration, design or construction of work of major importance, of which at least three years have been spent in duties of senior assistant engineer, or their equivalent, and at least three years in responsible charge of work. Fundamental training similar to that of Grade A.

Grade C: Under general administrative and technical direction to be in responsible charge of an intermediate division of an organization; to exercise independent engineering judgment and assume responsibility in studies and computations necessary for the preparation of reports, estimates, designs, specifications or valuations; to have immediate charge of construction, maintenance or operation of important works or projects; or to conduct or direct important lines of engineering research.

The qualifications include active professional practice or executive charge of work for at least five years, of which at least three years shall have been spent in duties of assistant engineer, or their equivalent, with at least one year in responsible charge of work. Fundamental training as for Grade A.

Grade D: Under specific administrative and technical direction to be responsible for the work of a minor subdivision of an organization; to collect and compile data for special items of engineering studies; to take immediate charge of field survey projects and of the design and construction of minor engineering work; to lay out and develop work from specifications and to supervise the work of a drafting or computing force; or to conduct specific tests or investigations of apparatus, materials or processes.

The qualifications include an experience of at least two years in duties of junior assistant engineer or their equivalent. Fundamental training as for Grade A.

2. Sub-Professional Engineering Service.—Grade E: Under immediate supervision to perform work involving the use of surveying, measuring and drafting instruments; to take charge of parties on survey or construction work; to design details from sketches or specifications; to compute and compile data for reports or records; to inspect or investigate minor details of engineering work.

No experience required other than that involved in securing a professional degree. In the absence of such a degree a high school education or its equivalent is required and at least four years' experience in the use of surveying, measuring or drafting instruments, or the computation and compilation of engineering data, together with evidence of a knowledge of the fundamentals of engineering science sufficient, with further experience, to qualify for the higher professional grades. Each full year of standard course of engineering instruction is equivalent to one year of experience.

3. Non-Professional Engineering Service—Grade F: To supervise the plotting of notes and maps; to direct the work of a drafting or computing squad; to direct work of field party on surveys or construction; to keep survey notes and engineering records; to supervise construction or repair work; to direct the work of computing surveys and estimates; to direct the making of minor engineering computations.

Experience required is at least five years in tracing, lettering, drafting and computing, with at least three years in the duties of draftsman. Or experience for at least five years in the use and care of surveying instruments, with at least three years as instrumentman. Education equivalent to graduation from high school. Each year of a standard course of engineering instruction is the equivalent of the experience otherwise required, with the provision, however, that at least one year shall have been spent as draftsman or instrumentman.

Grade G: To prepare general working drawings where design is furnished; to plot notes and prepare maps; to design simple structures; to make computations and compile data for reports and records; to check plans, surveys and

other engineering data; to use and adjust surveying instruments; to compute surveys and estimates; to make minor engineering computations; to inspect incidentally construction or repair work.

Experience is required for at least two years in tracing, lettering, drafting and computing, or two years as rodman. Education equivalent to graduation from high school and familiarity with the use of the slide rule, and of logarithmic and other simple mathematical tables; or familiarity with the construction, operation and care of surveying instruments. Each year of a standard course of engineering is equivalent to the experience otherwise required.

Grade H: To trace and letter maps and plans; to make simple drawings from sketches and data; to make minor calculations; to run tape or leveling rod; to perform other miscellaneous subordinate duties in survey party in field or office. Education equivalent to graduation from high school.

TABLE II. SCHEDULE OF SALARIES FOR ENGINEERS IN MANITOBA, CANADA

Grade	Positions	Monthly Salary Min. $	Max. $
	1. Railways		
A	Chief engineer	875	Up
	Asst. chief engineer	600	725
B	Principal asst. engineer	550	700
	Bridge, maintenance, construction, electrical and mechanical engineers	525	675
C	District, first assistant, assistant bridge, building, reconnoissance, water supply, combustion, signal, harbor, valuation and locating engineer	400	550
D	Division, right of way, second assistant, designing and assistant district engineers; and chief draftsman	300	425
E	Third assistant, resident and record engineers; inspector A, signal supervisor, rail inspector	200	325
F	Draftsman, levelman, transitman, inspector B, topographer	150	225
G	Junior draftsman, rodman, head chainman	100	150
H	Tracer, chainman, axman, blueprinter, asst. record engineer	90	125
	2. Public Works and Utilities		
A	Deputy minister and chief engineer of public works; highway, power and drainage commissioners; commissioners of any department of public works	650	Up
B	Chief engineer of highway, power or drainage departments; chief engineer of mechanical service; chief engineer of any dept. of public works, or public utility	500	Up
C	District, bridge, mechanical, electrical, construction and office engineers; engineer of urban municipality; surveyor	375	500
D	Assistant engineer, engineer of rural municipality, chief draftsman	300	375
E	Instrumentman	175	250
F	Draftsman, levelman, transitman, inspector	150	250
G	Rodman, junior draftsman	100	175
H	Tracer, chainman	90	150
	3. Municipal		
A	City engineer, deputy city engineer	600	Up
B	(No classification)		
C	Superintendents of water, streets, sewers and refuse disposal, chemical superintendent (tests)	350	450
D	Assistant engineer, water works chief engineer (mechanical)	300	400
E	Instrumentman	175	250
F	Draftsman, inspector	150	250
G	Rodman, junior draftsman	100	200
H	Tracer, chairman	90	150
	4. Industrial and Commercial		
A	Chief engineer	600	Up
B	Head of major engineering division	450	Up
C	Designing engineer	350	450
D	Chief draftsman, estimating engineer	300	350
E	Squad boss, checker	250	300
F	Senior detailer, draftsman	200	250
G	Detailer, junior draftsman, inspector	150	200
H	Tracer, blueprinter	90	150

The basic minimum and maximum salaries adopted for the several grades in the four main departments of engineering work are given in Table II above.

Twenty-Four Ton Truck Standard for Bridges

Wayne County, Mich., designs all its new highway bridges for 24-ton trucks, with a view to making full provision for future requirements. The standard minimum roadway width on bridges is 24 ft.

Engineer Schools Show Increase in Student Registration

WHETHER the war increased the demand for engineers or merely made the profession of engineering seem more attractive, returns from 65 engineering colleges to the Institute for Public Service, New York City, show that the increase in register during the three years after the war was nearly ten times that of the three years before the war. During the school year 1916-17, which had practically its full register before the war broke out, there were but 1,276 more engineering students in 65 technical schools than in 1914. In 1920, with a total of 35,132, there were 12,437 more than in 1917, and 13,713 more than in 1914.

In the six-year period 5 colleges lost where 17 lost from 1914 to 1917. After 1917 the register dropped in 6 colleges. Of 65 schools 9 added over 500 students each and 19 added over 300 each. Of 42 publicly supported engineering schools none had fewer students than in 1914 and only 1 had lost, Nevada, three students. Between 1914 and 1917 6 lost. Of 23 privately supported engineering schools 11 lost between 1914 and 1917 and 5 showed a net loss between 1914 and 1920. Of 20 largest schools not one showed a decrease between 1914 and 1920. California, Wisconsin, Pennsylvania, Cornell and Case had fewer students in 1917 than in 1914. Columbia reports a decrease from 675 in 1914 to 136 in 1920.

The twenty largest engineering schools reporting follow, with their gains since 1914 and their gains or losses in graduate training schools for teaching and research:

Institution	Size in 1920	Gained Since 1914	Gain or Loss in Graduate School
Cornell	2,115	726	264
Michigan	2,038	583	42
Illinois	1,768	566	49
Minnesota	1,547	897	391
Ohio State	1,488	600	75
Iowa State	1,372	700	206
California	1,358	544	267
Wisconsin	1,104	384	770
Rensselaer	1,017	391	
Pennsylvania State	1,016	375	22
Oregon State Agricultural	971	675	23
Kansas State Agricultural	916	629	Dec. 20
Washington	887	398	Dec. 27
Lehigh	847	306	38
Cincinnati	824	413	Dec. 1
Case	810	261	
Kansas	742	243	Dec. 7
Texas	727	317	47
Penn	696	96	179
North Carolina Agricultural	692	312	

With Minnesota, Iowa, Oregon State Agricultural, Kansas State Agricultural, Cincinnati, the following engineering schools more than doubled in six years:

Oklahoma	from 91 to 534	Utah Agricultural.	from 95 to 265
Geo. Washington	from 204 to 530	Alabama	from 101 to 210
Missouri	from 145 to 444	Tufts	from 197 to 210
Cal. Inst. Tech	from 58 to 365	Montana	from 64 to 190
West Virginia	from 118 to 330	Florida	from 51 to 150
Utah	from 174 to 327	South Carolina	from 28 to 58
Johns Hopkins	from 95 to 315		

Kansas County and Township Road Fund

Exclusive of Federal aid, Kansas raised $12,628,502.55 for county and township road and bridge work for 1919, according to a recent statement issued by W. C. Markham, secretary of the state highway commission. This is approximately 25 per cent more than was raised during 1918. About half of the total amount went into the county road and bridge fund; taxes for the township road and bridge fund raised another $4,000,000 in round numbers; and the automobile owners, through the motor vehicle license law, contributed $1,304,735.71.

Coördinated National Transport System Advanced

Addresses Before Annual Meeting of Am. Soc. M. E. Show Need for Correlating of Functions and Methods—Railroads, Terminals, Branch Lines, Highway, and Waterways—Abstracts of Papers

The Railroads and a Unified National Transportation System

By DANIEL WILLARD
President, Baltimore & Ohio Railroad Co.

FOR the purpose of outlining my own views concerning the larger problem I will repeat a portion of my report submitted to the Council of National Defense in November, 1917:

> A nation should have a national transportation system and such a system should embrace and make proper use of all available and suitable agencies. The fullest possible economic co-operation should be encouraged and required between all such agencies. Inasmuch as the business of transportation for hire partakes of a monopolistic character, all agencies so used should be subject to governmental regulation in the public interest. . . The co-ordinated transportation system of a nation should be so adjusted that each agency will perform the particular function for which it is best adapted, and, speaking broadly, that country which is provided with the most efficient transportation system—other things being equal—ought to be the most prosperous.

If we are to have a complete and well-articulated national transportation system it can only be had, as things are now, by the co-ordination of a number of different transportation agencies, including the steam and electric railways, the utilization of coastwise and inland waterways, the full economic use of highways, improved and unimproved, and the use of the motor truck. Of all of the transportation agencies at this time available, particularly for interior service, the steam railroad is undoubtedly the most important.

If this country were fully developed and if we had already reached the peak load which the railroads would be expected to carry, the railroad problem would be a much simpler one than it is under conditions as they actually do exist. At least $1,000,000,000 per annum must be provided as a minimum for capital expenditure to keep the railroads abreast of transportation requirements. The country cannot afford to experiment with any system of ownership or control of railroads unless it can provide, as needed, the necessary additional facilities. Personally, I believe the new Transportation Act will enable the railroads to do this. If it does not the law must be amended or some other method adopted. The only alternative would be ownership and operation by the government.

The carriers realizing that they were inadequately equipped decided last April that they must make the best use possible of available facilities. A campaign to increase car mileage and loading was initiated and I am confident that its aims will ultimately be reached and exceeded. In spite, however, of all that the carriers may be able to do with existing plants they will not be able to handle all of the business that this country is even now capable of producing. The productive capacity of the country has been greatly increased, but railroad facilities were not increased at all. The railroads were able to cope with the war situation, but in times of peace the people are not willing to accept the character of service given during the war nor is it in the interests of the people as a whole that they should be required to accept such service. In order that the carriers may be able properly to handle future business they must make very large expenditures not only for additional cars and engines, but for additional running tracks and particularly for additional terminals.

It is in the larger public interest that in developing a transportation system adequate to meet the requirements of growing commerce that each suitable agency of transportation should be used to the extent economically desirable. Where a given expenditure, if applied to water transportation, will provide for the movement of the traffic offered at a lower economic cost than an equal investment in any other transportation agency then water transportation should be developed; also if the use of the motor truck and improved highways in certain localities and for certain distances is shown to be cheaper, including all factors of cost, it should be used.

I do not believe that the motor truck can compete in long-haul traffic, but I do believe that for short-distance traffic in sparsely settled communities the motor truck not only on the improved highway but even on the ordinary dirt highway may be used in conjunction with the railway and thus afford the cheapest form of transportation. The same may be said of our inland waterways.

At various instances in the past railroads have taken business at a loss. The country would be better off if such business could be handled in such a way as would give a profit. There was a time when railway managers were believed to be opposed to the development of other means of transportation which might become competitive. But whatever may have been the attitude of the railway managers in the past that is not their attitude at the present time and I am certain that they will be glad collectively or individually to co-operate with all other transportation agencies in such a way as will inure to the greatest public good.

Terminals and Terminal Yards

By WILLIAM BARCLAY PARSONS
Consulting Engineer, New York City

TERMINALS form the largest item in railway construction cost and the most expensive item of cost in railway operation. Does it seem unlikely that at least 30 per cent of the physical valuation of the railways would be found in the terminals? To make a similar estimate of terminal operation cost would be more difficult since there is no segregation of cost figures. But terminal operating costs form so great a part of the total transportation expense that it is filled full of hope, if not of promise, for finding substantial economies.

If the shipper would avoid further raises in rates he can aid by focusing public attention on the unnecessary burdens of legislation, on failure of transportation companies to make the best use of their properties, or on the failure of public authorities to co-operate with the companies. Is there not great waste in duplication of service and in the use of badly located facilities? In the old competitive days it was necessary for each company to have its own complete terminals, and to prevent competitors from obtaining facilities as ample or as well located. If all the railways in any large American city had been combined would the previous methods of duplicated service have been maintained? The Chicago Terminal Commission has already answered this question by saying that "there are decided advantages in co-operative operation." Would there not be really great saving if all the terminal facilities in all large cities could be pooled and duplications avoided; the badly located facilities abandoned?

How can terminals be more economically operated is another question. What can the railways do and what can the shippers do? A few years ago shippers used both railway freight houses and cars as places of free storage and perhaps the only way in which this can be entirely stopped is by having the railway companies do all the unloading and delivery, either by their own agencies or by some authorized single agent acting for them. At London at about 3 a.m. incoming freight arrives at each station and by 7 a.m. the freight house and delivery trucks are full. An army of railway drays attacks the ordered pile of merchandise and by noon everything has been removed and de-

livered to consignees. At 4 p.m. outgoing freight begins to arrive by drays; by 8 p.m. the freight houses are full again, and by midnight the contents have been loaded into cars. In this country much of the terminal expense is caused by the shippers themselves doing their own trucking. With storedoor delivery trucks would carry full loads with the consequent minium of truck miles.

In New York no less than 25 per cent of Manhattan dock front is occupied by railway terminals or landing places where no one does business, but to which and from which the city's incoming and outgoing merchandise must be trucked daily. If the principle of storedoor delivery be adopted in New York there seems to be no necessity for waterfront terminals in New York and waterfront yards in New Jersey. New yards with switching connections at both ends can be constructed, with modern freight houses, and unloading tracks equipped with freight-handling, labor-saving machinery, located in any convenient place, even on the Jersey meadows. To them motor trucks with trailers carrying not part but full loads would transport merchandise between cars and points of origin or destination in any part of the metropolitan district. In such a system would there not be economy in handling, time saved in trans-terminal shipment, and relief to street congestion through diminished number of trucks? Besides, such large area of waterfront property, now held for local freight purposes only, would render available a site for the finest kind of ocean steamship terminals to relieve present congestion and overflow to other ports.

The two great things to be overcome if any radical improvement in the New York terminal situation is to be made are: First, the financial difficulty in the large amount of capital required; second, the political difficulty of two states, one on each side of the Hudson River. In addition there stands the difficulty of no less than eight municipalities on the Jersey shore. But there is needed a plan that will provide the much sought for economy in terminal operation, a plan that will consider the needs of the railways, the interest of the shipping public and the taxpayers, the development of that portion of New Jersey lying east of Newark and west of the City and State of New York and the serving of the country at large.

Motor Truck Transportation

By FRANCIS W. DAVIS
Engineer, Pierce-Arrow Motor Car Co.

IN THE short period of twenty years motor highway transportation in capital invested and diversified fields of application has reached the point where it is warranted in seeking counsel with its elder brothers. Except for certain specialized services the motor truck will never replace waterway and railway transportation, nor act in other than a supplemental capacity to these two. Three principal aspects of the problem are here considered: The field of truck transportation, the present status of truck transportation, the improvement of truck transportation.

It is in the short haul and at terminal points that the railways are at the greatest disadvantage, both as to service rendered and to their own earnings, and it is here that motor transportation comes as a help and relieves cars for the long hauls where they are most efficient.

The foregoing table shows the relative cost of shipping by rail and by truck for various lengths of haul. The figures for the railway include freight charge, teaming between terminal points and the increased cost and freight on boxing for railroad shipment.

If the express companies could save by using motor trucks in short haul, suburban service of the character, for instance, as between Germantown and Philadelphia, the practice is uneconomic that express companies, as I have been informed, are not allowed by their contracts with the railroads to ship to any point where they maintain an office and advertise tariffs by any other means than by rail irrespective of the distance.

COMPARISON OF THE COST OF DOOR-TO-DOOR DELIVERY OF FIRST CLASS L.CL. FREIGHT FROM BUFFALO TO VARIOUS POINTS.

Buffalo to	Miles	Flat Freight Rate	Total Cost by rail per 100 lb.*	Time by Freight (days)	Truck Rate per 100 lb.[1]	Time by Truck (hours)[2]
Tonawanda	10	.25	.83	2	.25	2
Niagara Falls	26	.28	.87	2	.35	4
Batavia	37	.31	.90	2	.60	5
Rochester	72	.38	.99	3	.80	9
Jamestown	77	.54	1.17	2	.90	9
Erie	92	.59	1.23	2	1.00	10
Ashtabula	129	.67	1.32	3	1.30	14
Elmira	145	.61	1.25	4	1.40	15
Syracuse	154	.56	1.20	2	1.50	16
Utica	203	.66	1.31	3	2.00	21
Binghamton	204	.70	1.36	3	2.00	21
Pittsburgh	241	.84	1.52	5	2.50	26
Albany	308	.72	1.38	4	3.00	31

*Total cost by rail per 100 lb. equals freight rate plus teaming charges, both ends, (.30), plus cost of extra boxing (.24) plus extra freight charge on increased weight of boxing (17 per cent of freight rate.) [1]Trucking Association figures (1920). [2]Loading and Unloading time of 1 hr. plus running time at 10 m.p.h.

THE TRUCK IN TERMINAL WORK

With the proper co-ordination the motor truck can aid materially in lowering terminal and transfer charges. The results obtained in Cincinnati in the use of motor trucks with demountable bodies show the possibility in the solution of terminal problems. Sixteen motor truck chassis with 225 unit-container interchangeable bodies were put in operation and have averaged 4.55 tons per load. Walker D. Hines, previously Director General of Railroads, has reported in connection with this installation in addition to quickness of dispatch a "saving of two handlings; 50 per cent decrease in damage to freight in loading and unloading, and decrease of about 15 per cent per ton in cost of handling." B. F. Fitch, president, Motor Terminals Co., New York and Cleveland [who developed the system of operation at Cincinnati] estimates that the installation of a terminal system in New York similar to that at Cincinnati would save $45,000,000 in freight costs yearly.

In the carrying of passengers the motor truck or bus is taking its place as a feeder to the street railway. In 1918 the General Omnibus Co. in London carried a total of 682,000,000 passengers against 699,000,000 on the underground and 992,000,000 on the street railways—more passengers by bus than all the *surface* railway lines of the boroughs of Manhattan and the Bronx in New York City. Bus advocates do not look for the elimination of the street railway but for its use as an auxiliary and a feeder.

Possibly the most interesting phase in the development of the motor truck opening new fields in each new application is in "combination service," for which the truck engine is used for other purposes than driving the truck. It is available for auxiliary purposes, such as the driving of winches, cranes, pumps and for miscellaneous power requirements. As an instance of this, this winter New York City will have a fleet of caterpillar tractors operating snow plows for use in snow removal. Now, approximately 50 per cent of the larger trucks are equipped for some form of auxiliary device utilizing the power of the engine.

In the present status of truck transportation we find 800,000 trucks in operation, and if each of these average 5 tons per day for 300 working days per year the total tons moved by truck would be about 1,200,000,000. In 1918 about 2,504,000,000 tons of freight were moved by the railroads. Estimates of the Firestone Co. covering cost analysis of a number of fleets of from one to forty trucks, all of 5-ton capacity, show a daily mileage of each truck of 40.5 miles with labor approximately 37 per cent of the total cost. The motor truck owner is confronted with the less-than-carload shipment, which in his case is the less-than-truckload shipment, and due to the extremely short haul of the motor truck, loading and unloading time becomes of very great consequence. For one-mile haul, with 60 min. loading plus unloading time, the truck accomplishes nine trips per day; with a 5-min. time, sixty trips; with 1-min. time, ninety trips, or an increase of 1,000 per cent.

The question of possible increase in size of motor trucks is an economic one with respect to present carrying capacity of many highways and bridges and the unmanageability of vehicles over five or six tons capacity. The development

is intimately related to the rubber tire. The pneumatic tire promises betterment in increasing traction, absorbing road shocks and protecting highways.

In the improvement of truck transportation the improvement of highways is of paramount importance. Proper surfacing and foundations are the greatest need. Grades are of very little importance if the roadbed is right, but it will be necessary to have bridges of ample capacity to take maximum load. The ideal highway development is a comprehensive system of national highway under Federal control.

In conclusion, railway transportation should and will hold its place for long hauls and for carload shipments where there is direct railway connection to the factory or warehouse of the shipper. Motor transportation will relieve the railways of the expensive short haul; serve them at terminals and act as a feeder. It will supplement the street railways and spread in the field for utilizing the engine for auxiliary purposes. With the improvement of devices for shortening loading and unloading time there will be a reduction in the use of horses for heavy freight haulage. The economic limit of the size of motor trucks will probably not increase, although the use of trailers will increase tons hauled.

Feeders for Railroads

By CHARLES A. MORSE
Chief Engineer, Chicago, Rock Island & Pacific Ry.

IN THE past, due to unrestricted competition, many railroad facilities have been duplicated, such as tracks from two or more lines into the same industry, branches of two or more railroads running side by side where one line would do double the business done by all. Under the Transportation Act the Interstate Commerce Commission is required to permit rates to the railroads, in addition to paying operating expenses, including a fair amount for depreciation, to yield a return of 6 per cent on a fair value of the property devoted to transportation purposes either on the railroads as a whole or divided into groups. The public should not have to pay the cost of maintenance and upkeep, the cost of operation and interest on the investment in duplicate property. There are many branch lines less than 50 miles in length that are built to control the territory on either side of a main line. Such lines were built as a rule when there were only ordinary dirt wagon roads and all teaming was done with animals. Today with the advent of the automobile and the motor truck have come the "good roads." A careful study should be made of branch lines of railroads, and where there are "good roads" of the hard-surfaced class, over which the business now handled by the railroad can be handled by motor trucks and buses, the matter of dismantling the branch line of the railroad should be given serious consideration.

WHERE FEEDERS ARE NECESSARY

On the other hand, there are railroads that have undeveloped territory adjacent to their lines which will warrant the construction of feed lines and increase their main-line business, and these railroads should apply to the Interstate Commerce Commission for authority to construct such lines and for a freight and passenger rate over the new line that will pay a proper return on the investment and the cost of maintenance and operation of the line. Some of the more prosperous railroads have systematically constructed feeder lines and their prosperity under adverse conditions has been due largely to this policy where it has been carried out in developing new territory. Some of the more prosperous railroads have systematically constructed feeder lines and their prosperity under adverse conditions has been due largely to this policy where it has been carried out in developing new territory.

Branch lines were formerly cheaply built, at from $12,000 to $15,000 per mile; they had narrow roadbeds, light rail, light bridges and less ties per rail than main lines; they were equipped with locomotives that had become too light for main line traffic, but handled the short branch line trains.

In the development of traction—both steam and electric—locomotives have become so heavy as to require strengthening of the roadbed and tracks, and since provision must be made on branch lines as well as main lines for carrying heavy power, the former become almost as expensive as the latter. It can readily be seen that with the introduction of a class of locomotive—the motor truck—that requires no rails but which can be used by the public at large that the use of the railroad within the limits of the practical use of a single unit of transportation must become less and less as good roads are constructed. The public is paying for the good roads and the motor cars and now under the Transportation Act they must pay for the maintenance and operation and also the interest on the value of the branch lines of railroads. If the public were required, as it should be, to pay a rate on the branch line that would pay the cost of upkeep, operation and interest on investment, it would pay as much in many cases as it costs to haul the freight to the main line by motor trucks. If many of these branch lines that are tributary to a territory within the limits of auto-bus and auto-truck service could be taken up and abandoned it would mean a reduction in cost of main-line service.

Where branch lines are long enough and they cannot be replaced with motor service and do not connect with or cross other railroads there should be a rate that would yield an amount sufficient to cover all operating, including capital costs. Present practice in this respect is the discrimination of the few against the many.

ABANDONMENT OF BRANCH LINES

In considering the question of abandoning a branch line a careful study of the situation on each railroad should be made and the useless branch lines should be listed and a program made up to cover a period of five to seven years, at the end of which period they would all be up and charged to operation and capital account on which the public must pay a return which would be reduced that much and in addition the public would be relieved of the operating cost. With the completion of such a program there would be such a reduction in investment as would go far toward providing for new construction to develop new territory. Branch lines are a necessity, but in abandoning them the railroads must deliver more freight at main-line stations resulting in an increased use of cars from time saved in movement between main-line and branch-line stations. L.C.L. freight should be collected for all railroads at the various stations in the city and should be taken to a central point by one railroad or terminal company and there made up into carloads and billed over the railroads to which it is assigned and the cost of this service kept separate. Those desiring to deliver l.c.l. freight to the point of consolidation by motor truck would save this special charge for collecting the l.c.l. freight.

In order to permit the Interstate Commerce Commission to handle the question of new lines and abandonment of old lines it is going to be necessary to have all railroad charters issued as national rather than state charters. There would have to be a campaign of education which would show the public that the changes advocated would be for the good of the great majority of the people. People on branch lines will object to their abandonment, but, while we are rearranging our transportation facilities, we should weed out all special privileges and make every one pay for what he gets.

The railroads are going to be able to make many changes in maintenance and operation that will tend to decrease the cost to the public if the Interstate Commerce Commission takes a broad view of the transportation situation and handles its regulation along economic lines as a national rather than a local matter and does not let local interests interfere with the carrying out of broad national policies.

[For lack of space in this issue, the report of the addresses of Gen. Frank T. Hines, on waterways, and of Gustav Lindenthal, on the Hudson River bridge project, will appear next week.—EDITOR.]

Construction Revival—When?

Price Stabilization Must Come First—Public Waiting for Lower Materials Prices

By Owen M. Fox
Construction News Department, *Engineering News-Record*

TO INSURE a busy year in 1921 and to make possible the progress of needed housing and public-works construction definite action on price revision seems necessary. Only stable prices will encourage building. Buying is always at a minimum when prices are on a decline and at its best on the upward trend.

There is a lack of confidence in the stability of present-day costs, or, stated differently, a conviction that construction cost will soon be much lower. No industrial company cares to put a million dollars in the erection of a plant which six months hence may possibly be built for $600,000. No financial institution can risk financing such a project. No public official dares spend public moneys except for urgent work under such conditions.

The necessity of stabilizing costs, not only in fact but also in the public mind, is therefore apparent. Labor has already taken long strides in this direction. In Chicago, for instance, the building trades have agreed that there shall be no wage or working-condition agitation for eighteen months. At no time in recent years have there been so few strikes and lockouts and it has been a long time since labor has been so plentiful. Efficiency, by common agreement, ranks from 12½ to 30 per cent higher than during the silk-shirt days, but labor is almost the only construction element that shows cost decline.

Materials Reductions Lagging

Reductions in building-materials prices during the past ten weeks have been remarkably few in comparison with those of other commodities. Much has been made over a drop of from 30 to 40 per cent in lumber costs, but lumber cost, after all, is such a small portion of the whole expense of general construction that the influence of this movement is almost negligible. The general public from whom, in the last analysis, all buying movements come, whether of cotton cloth or concrete warehouses, seems intuitively aware of the facts indicated by the weighted index figure of prices issued by the Bureau of Labor Statistics at Washington. This shows a decline of about 53 points, or 23 per cent, since May 1, but shows also that during this time building materials in the aggregate have shown but 8 per cent decline.

People recall that while building-material prices have been receding 8 per cent textiles have gone back 35 per cent; farm products, 30 per cent; metal products, 29 per cent, and that all commodities, including building material, have dropped the 23 per cent mentioned in the foregoing paragraph. They recall that the 8-per cent decline in building materials has been confined almost exclusively to lumber and sheet and structural steel, and are asking why brick, cement, sand, gravel, lime, reinforcing metal, etc., do not do their share.

Would-be investors cannot help but note that in most lines in which but slight reductions have occurred the reason is offered that the price increases were less than the average during the period from 1913 to May, 1920. Such is not true of building material. Again citing the Bureau of Labor Statistics, we find that farm products advanced during that period 146 per cent; foodstuffs, 187 per cent; metal products, 157 per cent; chemicals, 152 per cent, and that building materials advanced 241 per cent, being exceeded only by textiles, 256 per cent, and house furnishings, 271 per cent.

The above recital is given to point out the frame of mind of the public, and to indicate the necessary steps that must be taken to change that attitude, which is apparently so determined as to make impossible any immediate improvement in construction.

In other industries reductions by manufacturers and first hands have compelled cuts all along the line and have caused holders of intermediate stocks to stand losses in shrunken inventories. In the building field such losses are not necessary as dealers and jobbers have no vast supplies stored. It is more nearly a direct producer-to-user business.

Effect on Volume of Work

Apparently the opinion of "the man in the street" is going to have a great deal to do with the immediate future of construction. Any great private construction movement will come largely from the erection of individual homes and small flat buildings and the owners of such projects are governed largely by their opinion of conditions in general rather than by any knowledge of conditions in the building industry. It seems probable that the growth of industrial plants in America in 1918 and 1919 has discounted the need for a large additional amount of factory space at present. The present trend of financial venture seems to be toward either long-time, non-speculative investment or short-time, high-return, speculative investment, which would preclude an unusual volume of apartment or office-building construction.

In public statements, in testimony before the Senate committee and in private conversations, producers of materials are a unit in stating that reductions at the present time are not justified by lowered costs. Opinion seems to be about as unanimous that cuts will be justified in the course of a few months—possibly by March first, though Eastern opinion has inclined to expect earlier reduction. Decisions as regards construction next year are being made now. Every engineer and architect in the country is busy on plans which will either be postponed or advanced in the next few weeks. Bond issues for public works are coming to a vote or being offered for sale.

The longer the coming readjustment of price is delayed the less new work will be undertaken in the coming year. It seems that the wise thing to do is to make immediate surveys in every line, to determine the level at which the price should be maintained next year. These surveys should take into consideration every factor which goes to reduce costs—improved transportation, cheaper coal, reduced labor cost due to wage reductions (if any) or increased efficiency and lowered interest rates on investment. The price, when determined, should be put into immediate effect, even at the cost of a temporary loss.

This is not a matter of charity to would-be builders. It is purely a problem in merchandising. That which will work to the ultimate benefit of a trade in general is a wise thing to do even if it involves a present sacrifice on the part of the seller and permits particularly advantageous buying, for the time being, on the part of the consumer. Such a movement, at the present

time, holds promise of greater benefit to the construction industry during the next year than has ever seemed possible at a similar period.

Sufficient plans for construction are now "on the boards" to insure, should the major portion of them go ahead, a banner year in 1921. Reports from every city of the country show millions and even hundreds of millions of dollars worth of construction scheduled to go ahead *as soon as conditions permit.*

PRESENT CONDITIONS

Current tendencies in the industrial and financial world are encouraging, not for the outlook they give for the next few weeks, but for the promise of a good year in 1921. The process of descending from the perilous peak of inflation, which existed at the beginning of this year, is well under way and seems certain of accomplishment without the morale destroying shock that was feared.

Nearly all sections report decreased volume of construction, the Pacific Coast region being the exception. Building is going on there at a high rate, Los Angeles and vicinity showing particular activity.

Throughout the Mississippi Valley construction is standing still. The steel-producing section reports a plentiful supply of ore stored, pending the close of Lakes navigation, to insure any needed steel production this winter, and coal supplies are also assured in all sections. Lessened demand is noted for steel products and is being reflected in reduced output, several plants having shut down a portion of their furnaces. The tendency of farmers in the West to withhold fall crops from market on account of falling prices is being defeated by the forced calling of loans by the banks.

While the buying power of the nation seems to be reduced on account of the fall in agricultural prices, lessened sales are attributed chiefly to a spirit of economy and uncertainty as to the future. Necessary liquidation of inflated values, both in materials and securities, is proceeding systematically and in a manner which should render all elements sound and provide a basis for real prosperity in all lines when once the new level of buying power of the dollar has been established.

Utility of Liquid Oxygen as Explosive

At a series of addresses given recently before engineer organizations in the principal Western cities George S. Rice, chief mining engineer of the Bureau of Mines, called attention to the advantages of liquid oxygen as a substitute for dynamite in certain types of blasting operations.

At the request of the Bureau of Mines Dr. C. L. Parsons, the secretary of the American Chemical Society, looked into the use being made of liquid oxygen explosives in Germany. Dr. Parsons recently returned from Europe and in his report he expresses the opinion that liquid oxygen can be used to great advantage in this country. He bases this opinion on the successful way in which that explosive is being used in Germany. Its use is by no means confined to mines, he states, but extend to all types of work where blasting is required. The Germans have developed machines, he says, for the making of liquid oxygen which can be placed on motor trucks and operated by the truck's engine. Machines of this character are made as small as seven liters an hour capacity.

Minnesota Creates State Trunk-Line Highway System

A SYSTEM of trunk-line state highways aggregating 6,900 miles was created in Minnesota by an amendment to the state constitution at the general election Nov. 2. This amendment is peculiar, in comparison with the highway amendments submitted to vote in other states, in that it definitely prescribes the 70 trunk-line routes composing the system, and specifies the manner in which the improvements of these highways shall be financed.

Briefly, the 70 trunk-line roads aggregate 6,900 miles which are to be improved and maintained by the state. In case of the creation of new counties or the relocation of county seats the legislature may add to this mileage the new routes necessary to connect the new county seats with the main system. The legislature may also create additional routes whenever 75 per cent of the present mileage has been permanently improved. To finance the improvement a trunk-highway sinking fund, realized by taxes on motor vehicles, is to be created by the legislature. With the creation of this fund, which can be used only to pay interest on and to retire highway improvement bonds, the legislature can authorize bond issues not to exceed $10,000,000 annually nor a total of $75,000,000.

USE OF FUNDS

It is to be noted that the new trunk-line highway system will be constructed and maintained by independent funds. No money now raised by state aid, or county or township levies, will be used on this system. These funds in the last two years have averaged about $16,000,000 a year. Previously, the roads included in the new trunk-line system have absorbed about 75 per cent of this money. By the present plan it will all be expended on the secondary county and township roads. It is estimated that in 1921 the aggregate of all funds available in Minnesota for highway improvement will be $27,000,000.

In general the policy of improvement will be as follows: The state will use gravel surfacing, concrete, brick, and all other materials as conditions require and as the counties and towns are now doing and will continue to do. Contrary to impressions, the amendment makes no reference to the kinds of roads which may be built. Hard-surfaced or gravel roads will be built according to traffic and other actual conditions and every road will be improved as judgment and economy demand. Where heavy traffic pounds and pulverizes the gravel, paving will be necessary, and will be laid as rapidly as conditions require and funds will permit. Much gravel surfacing, where it meets present traffic requirements, will be used as the state extends the system of permanent roads. But every road will be improved, graded and drained to insure the best possible service throughout the entire year.

Automobile Fatalities in 1919

According to a bulletin recently issued by the Department of Commerce, Bureau of the Census, automobile fatalities reached a high figure of 3,808 during 1919. This represents a ratio of 14.1 per 100,000 of population. Of this number, fatal automobile accidents in Greater New York alone totaled 780. The automobile fatality rate in 1915 was 8 per 100,000 of population.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Structural Steelwork from British and American Viewpoints

Sir—An appraisal of the relative merits of British and American technical literature was suggested in R. Fleming's review of a British textbook on structural steelwork by E. G. Beck, published in *Engineering News-Record*, Sept. 16, 1920, p. 568. Such an appraisal would necessitate much work in comparison with its ultimate value, but a brief discussion on the general subject may be of interest.

A search through the best London libraries containing up-to-date books of both countries fails to reveal any British work which can compare with American monuments to the subject, such as Johnson, Bryan and Turneaure, Ketchum and others of similar merit. From discussion with British engineers it appears that those whose methods and designs are up to date have, almost without exception, studied American or German literature, while those who have confined themselves to the work of their own country reveal the fact in the results they obtain, and the cost of the work for which they are responsible.

Generally speaking, British books may be roughly divided into two classes, theoretical and practical. The works of theory are frequently little more than studies in higher mathematics, having considerable merit if the student desires mental exercises, but being of little use to those who have to design a bridge and need a book of reference. Their failings are a lack of practical suggestion as to the suitable dead and live loads to apply, and little advice as to what are the most suitable and economical sections and details to use after the stresses have been determined. In other words, they start on the assumption that the load is known and that the design is simple if the stresses are known. Economic spans and depths are rarely discussed.

The so-called practical books frequently make a parade of the fact that no calculation involves the calculus. As the subject cannot be covered without at least an elementary knowledge of the calculus, they thus fail to interest the more ambitious students. This class of work does make some attempt to indicate loads to be allowed for, and after indicating an empirical method of obtaining the stress, proceeds to questions of sections and details. It is here that they generally fail. Sizes are suggested that are costly and difficult to obtain, and details are shown which would not be tolerated in America and are undesirable for the majority of British structures.

Most English books devote much unnecessary space to stresses in roof trusses due to wind loads normal to the surface. It seems to be overlooked that at best such stress allowances are only an approximation and that equal results could be obtained for ordinary cases with a fraction of the labor by an assumed vertical load. These books give scant attention to rolling loads. Critical positions of wheels and the use of influence lines are not generally known.

In dealing with columns and struts, American books pay less attention than British to the condition of the ends. It would seem advisable in both textbooks and specifications to state clearly to what conditions of ends the formulae suggested are intended to apply. The British student of American books very reasonably doubts the justice of using the same formulae for pin-connected struts as for those with riveted ends.

The book reviews which appear in the English technical press are no guide. It is to be feared that they are written to aid sales. They rarely contain candid criticism, as would be the case if they were written by an engineer who needed a reference book.

The educational facilities in the two countries appear to differ considerably. The young British structural engineer just out of college is not capable of designing anything but the simplest structures, and has all his details to learn so far as commercial work is concerned. The American is better equipped in this respect, but on the other hand the Briton seems to have a much better general knowledge of engineering, and will know something of electrical and mechanical work, foundry, smithing and machine shop practice. In the United States, highly specialized structural engineers with an appalling ignorance on general subject are frequently met—men who do not know the difference between D.C. and A.C., and who have little conception of mechanical work. They also seem to know less of general conditions which affect the sale of the work they handle, particularly in countries outside the United States. This may be due to the fact that more men go abroad from the older country to places where they may have to tackle all kinds of work and be many miles from help or even advice.

The differences between the practice in the two countries is due to the difference in fundamental conditions which prevailed before the war. In Europe, labor was cheap, and, therefore, no effort was made to design economical details. The expensive labor in the United States necessitated simple details. The quantity of structural steel used in the United States is so far in excess of that used in Great Britain that American designers have had more opportunity of investigating economic designs; consequently, it is now usual to find American bridges lighter than British—loads and stresses being the same in both cases. There are some fearful examples of structural atrocities in Great Britain, and one does not need to go outside London to find many of them. There are many spans with shallow trusses and multiple web systems without lateral bracing to the top chords. One wonders what length the designer assumed in figuring these members as struts. The only conclusion is that these freak structures have never carried anything like the load the designer thought he was providing for. Such structures give the impression that they might be strengthened simultaneously with a considerable reduction in weight and saving in cost. In showing an American visitor these structures, one must be apologetic.

The bridge carrying the Northeastern Railway over the Wear at Sunderland is a curious design. It is a

through-truss span with parabolic top chord, and evidently figured on the basis that such a span has no web stresses for it has no diagonals. The partly loaded span does not appear to have been considered but as the result apparently did not "look right" the spaces between the verticals were completely filled in by huge plate gussets with one large oval hole in the center proportional to the size of the panel. A student of secondary stresses due to deformation under partial loading could have no finer example than this.

The difference between American and British building work is much less marked than is the case with bridgework.

Aesthetically, America has something to learn from Britain, where one rarely sees a beautiful landscape spoiled by an ugly steel bridge which, with only a little extra cost, might be made to look more in harmony with its surroundings.

There is no doubt that structural steel engineering has made but little progress in Britain for many years, especially when compared with that made in other branches. This is probably due to the following facts: The railroads do their own designing by engineers trained in their own office, and who have, therefore, little opportunity of acquiring modern ideas. Most other work is designed by consulting engineers or architects who have little qualification for the work and treat it as an unimportant side line. The manufacturing units are small, and, therefore, have no chance of specializing in any particular class of work.

There *are* good British designers, but they are mostly attached to the manufacturing concerns, and, therefore, only get a small proportion of important work to design.

As an Englishman it is naturally unpleasant to have so little to say in favor of British work, but if adverse criticism will help to rouse more interest in this subject, it will be for the benefit of both users and manufacturers.

H. R. WHITE,
Resident Engineer, U. S. Steel Products Co.,
London, England.

Sir—The letter by P. L. Pratley in the Engineering Literature section of your issue of Nov. 18, contains some statements that call for comment from American engineers. Mr. Pratley seems to favor strongly European or English practice of designing largely by judgment. He would commend a plan of designing without strain sheets, even for enormous structures such as the Forth Bridge. Would he fabricate without any detail drawing? It would be a logical step from the premise just stated. He discredits analysis and the taking care of details—proportioning them for their load and each part for its own load. He says, "There is no structural argument against bent angles." Such statements can only serve to confuse the unwary.

If analysis is useless, books should be burned, engineering periodicals suppressed, and engineering schools abolished. No book nor paper nor school can teach judgment nor even impart experience, the thing Mr. Pratley so exalts.

There is indeed the soundest of structural argument against bent angles, particularly as used in the flying buttress end stiffeners in plate girders which Mr. Pratley defends.

Some years ago a paper of mine was read before the Western Society of Engineers on a comparison between European and American practice in railroad bridge design (very fully reprinted in *Engineering Record*, March 1, 1913, p. 244). I condemned just such things as the wide spreading bearing plates on girders and slender bent angles to stiffen them—a detail that could not possibly distribute the load of the girder on the bottom area of the bearing plate. Compression members with wide, thin outstanding flanges were also condemned—a common style of compression members used where analysis of stress and study of test results are ignored. One European bridge failure occurred as a result of this style of design.

Mr. Pratley would have us believe that Europe's engineering practices are being adopted in America because, forsooth, pin-connected bridges are not as common here now as they used to be. It is a far cry from the growing preference in America for riveted trusses to the adoption of the European practice of building a structure by "experience" and then nursing that structure for its lifetime by frequent inspection and watching, as European practice seems to require. American bridges need no nursing,—only occasional painting—if designed on the principles and analysis set forth in American books and periodicals.

I wrote a paper on common practice in structural designing which was published in *Engineering News*, April 11, 1907, p. 394. This paper condemned many details of bridge design which showed lack of analysis. Prof. W. C. Kernot, of the University of Melbourne, Australia, an authority on structural engineering, wrote me commending this paper and sent me a book of his written along similar lines. So it is not exclusively an American trait to design bridges by scientific rule.

Pittsburgh, Dec. 4. EDWARD GODFREY.

Specification for Steel Railway Bridges

STANDARD SPECIFICATION FOR STEEL RAILWAY BRIDGES: Canadian Engineering Standards Association—Ottawa, Can.: The Association. Paper; 6 x 9 in.; pp. 79.

This specification applies to steel railway bridges up to 500 ft. span and movable bridges, except suspension bridges and locomotive turntables. It is based on the specification of the Engineering Institute of Canada, originally issued (by the Canadian Society of Civil Engineers) in 1912 and revised under date of 1919. As the council of the Institute subsequently approved the proposal of the newly formed Canadian Engineering Standards Association to deal with the specification as final authority, and as the membership of the association's subcommittee responsible for the present specification is identical with that of the Engineering Institute's committee by which the 1919 specification was prepared, the present may be regarded as the successor of the 1919 specification.

It will prove interesting and instructive to American bridge engineers in many ways, both through its general form and through details. Being relatively short and compact it contrasts with the latest specification of the American Railway Engineering Association, as it does also in including movable bridges and in using a parabolic column formula. No standard loading is specified. Braking force is varied with the span, decreasing from 22 to 10 per cent. The preface states: "It is believed that the specification in its present form, while not in absolute agreement with the American specifications on all points, will be found to be in substantial agreement therewith, the principal points of difference being such as are found desirable in order to comply with Canadian conditions."

Foundation and Substructure Problems

REVIEWED BY A. W. BUEL

Consulting Engineer, New York City

ENGINEERING AND BUILDING FOUNDATIONS: Including Sub-Aqueous Foundations—By Charles Evan Fowler, C. E., M. Am. Soc. C. E.; Member Engineering Institute of Canada, etc., Vol. I: Ordinary Foundations. Fourth Edition Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 531; illustrated. $5.

A revision and amplification of earlier books by the author presents itself here as the first of three volumes which together are to deal with the subject of foundations. A fair appraisal of one volume of a three-volume work without seeing the other two is obviously difficult, especially when there is room for questioning the particular division of the field among the three volumes. Yet it may be said at the outset that the volume under review, standing alone, should find ready welcome to the intimate book shelves of all engineers and constructors who are concerned with foundation and substructure problems. If Vols. II and III measure up to the standard set by, and supply what is lacking in, Vol. I, the complete work may claim to be ranked as an exceptional and notable contribution to engineering literature; it will undoubtedly be the leading treatise in the English language on design, construction methods and plant for substructure work.

"Ordinary" foundations are dealt with in the present volume. Vol. II is to cover pneumatic and open caissons, deep foundations, building foundations, underpinning, foundations for machinery, dams, seawalls, drydocks and locks; methods and forms for concreting; and cost estimates. Vol. III will cover the design and construction of harbors, piers and wharves, harbor tunnels—all unusual subjects for a book on foundations—besides rockfill foundations, dredges, dredging pumps tugs and scows, diving, and quarrying.

Is a "building foundation" an ordinary foundation"? The reviewer will not venture an answer here, but he feels free to state that the present Vol. I does not cover all the subjects one would naturally expect to find its title to include. Largely it is confined to subaqueous foundations of moderate depth—an important class no doubt, but by no means the whole of the "ordinary" class. More specifically, Fowler's "ordinary" foundations are chiefly bridge substructures where the site can be unwatered with cofferdams or sheetpiling, or the construction carried out in open caissons sunk in place, say in depths not exceeding 35 ft. Within this range, however, it does not restrict itself to design or working methods but brings together a considerable amount of information of great value on the selection and details of plant, matter brought together for the first time. This part of the book is likely to prove an agreeable surprise to many an engineer.

Possibly the needs of many readers would have been better served had the large amount of matter on plant and equipment in this volume (and presumably also in the two subsequent ones) been segregated to form an independent volume. This question, however, is similar to the one above as to why building foundations are not included. It is likely, in short, that those who need Vol. I in their work will find that they also need Vols. II and III, especially if their interest or practice is at all general or covers a broad range. For example, methods and forms for concreting are surely just as much needed in "ordinary" foundations as in others.

Some of the preceding comments have been directed at omissions from the present volume. The reviewer would not, however, critisize the inclusion of matter that he himself might have reserved for a later volume for, what one man might exclude as of small value, another, who is differently situated as to region and class of practice, might find vitally necessary. Thus, examples of crib cofferdams given in the second and third chapters, may be applicable to conditions in sections where timber is cheap, while they would prove uneconomical where steel, concrete, highly developed plant and skilled labor are available and at low price. In a new country it is natural to resort to old precedents, and the author has liberally provided for such needs without neglecting the requirements of sections favored with a higher industrial development.

Summarizing the present volume, its eighteen chapters and eleven appendices may be described as covering historical development, cofferdams, piledriving, sheet-piles, drivers, pile jetting, removal of old piers, pumping and dredging, foundation design, piers, retaining walls, abutments, culverts, timber piers, wood preservation, specifications, steel sheetpiling, and finally recent pile-driving data.

In the extensive treatment of piledriving, jetting and sheet-pile construction (Chapters IV to VII, and Appendix XI) a satisfactory practical treatment of the subject is found, with an important exception however: Reinforced-concrete piles and sheetpiles are inadequately dealt with, and examples of exceptionally large sections are missing. Of the various dangers and difficulties that must be guarded against and overcome in the use of concrete piling only one is briefly mentioned. The reader is referred to Vols. II and III for cost and description, respectively, of "the use of ordinary reinforced rectangular concrete sheetpiling."

Because of the troubles and losses so often incurred through providing insufficient pumping capacity—suitably mentioned in the Introduction—Chap. IX, on pumping and dredging, will be widely welcomed for the ample data it gives on pumping capacity and required steam supply.

Seven chapters following relate chiefly to ordinary bridge substructures. They cover the foundations, soil pressures, the location, design and calculation of piers and footings and the like, various types of masonry abutment, and the design of pier masonry. Comprehensive tables of quantities for preliminary estimates are included. Interpreted solely with regard to bridge substructure of normal type, these chapters leave little to be desired. But it is not apparent to the reviewer why they should not have been extended to apply also to foundations and footings on land, whether for bridges, buildings or other structures. The possible future lowering of groundwater level impervious soils and its effect on foundation settlement are not treated. Possibly the author has reserved the subject for discussion in connection with building foundations in Vol. II.

Two details in these chapters attract special notice. The formula for length of span to give least cost of structure does not appear to offer much advantage over the old method of equating cost of the complete substructure and superstructure. The treatment of test borings omits some recent details and methods, and little is given to aid in determining the number and location of borings or how far they should penetrate the rock (or other foundation stratum), so as to make it possible to lay out a reasonable tentative plan for the explora-

tion. A record of some precedents, accompanied by proper data, would have proved useful here. In a recent case one boring at each pier site proved to be entirely insufficient, the result being very deceptive, so that additional cost of construction amounting to many thousands of dollars became necessary. Had the author enlarged on the relation of geological formation to the number of borings required to determine the probable foundation conditions it would have improved this part of the work distinctly.

Other sections of the book, such as those on historical development, on removal of old piers, on timber piers and wood preservation, require no special comment. A chapter on retaining walls and culverts, however, should meet with an appreciative reception on its merits in spite of the fact that it would hardly be expected under the title of the present volume.

Of the eleven appendices, nine are devoted to specifications, one to steel sheetpiling, and the eleventh (already mentioned) to recent piledriving data.

The book as a whole represents an immense amount of labor. For due credit it should also be remarked that the illustrations are not only ample but unusually clear. A tabular synopsis of 47 cofferdam examples is especially valuable. The index, though not as full as desirable and containing several obvious errors, is fair.

On p. 434 the author presents his patents to the engineering profession—an unusual action. In the reviewer's opinion he deserves commendation for his action, which puts into concrete form an old-time rule of professional ethics, now perhaps obsolete but still regarded by many civil engineers.

Chinese-American Engineering Journal

JOURNAL OF THE ASSOCIATION OF CHINESE AND AMERICAN ENGINEERS: Vol. I., No. I., Sept., 1920—Peking, China: P. Y. Tsai, Secy., c/o The Chuchow-Chinchow Railway. Paper; 6 x 9 in.; pp. 44; illustrated. 50c.

The initial number of the *Journal* noted above contains a spirited Introduction stating in most friendly terms a number of reasons for an association of Chinese and American engineers. To quote:

As a country China is similar in many respects to America and since each year sees more of her sons educated in the schools and colleges of America, and each year sees a larger number of these students returning to China, it is only natural that the engineers of China and the engineers of America should co-operate and work together in the development of this country along modern scientific lines; for China, though old in history and culture, is new in her present form of government and in the science of engineering.

Having studied the same courses in the same colleges and universities in America where the same ideas and ideals were inculcated in the minds of both Chinese and American engineers, it is but natural that there should be and is much in common between the large number of Chinese engineers educated in America and American engineers now resident in China.

After stating that the objects of the association are to advance engineering knowledge and practice and promote co-operation among engineers, the Introduction emphasizes the need for trained engineers and other technical men in China and predicts a great industrial and engineering future for that country.

This issue of the *Journal* has a brief article on the surveys of the Chuchow-Chinchow and Chouchiakou-Hsiangyang railways lines, besides other short articles, numerous news notes and personals and a list of members.

High Points in the Life of Hoover

THE MAKING OF HERBERT HOOVER—By Rose Wilder Lane. New York: The Century Co. Cloth; 5 x 8 in.; pp. 356. $2.50.

Beginning, as all good biographies should, with a sketch of his forebears the author rapidly outlines the high points in the life of Herbert Hoover from his boyhood in Iowa and Oregon until he became known around the world, first in mining and financial circles as an engineer of remarkable technical and financial ability and then, and still more widely, as the head of the Belgian Relief Commission and the U. S. Food Administration. Throughout the author dwells on "the making" of Hoover—in character and in organizing, technical and financial ability.

How rapid Hoover's professional progress was is shown in part by the fact that at twenty-four he was engineer of mines for the Chinese government, while soon afterward he became a partner in the large mining house in London for which he had done brilliant work in Australia before going to China. At forty he began his great war work.

Both in matter and method the volume makes a strong appeal. It cannot fail to interest engineers. It is a good book for boys and young men and, regardless of age, should stimulate any one to a life of service and all-round personal development.

Irrigation Engineers' Note-Book Expanded

IRRIGATION POCKET BOOK (Or, Facts, Figures, and Formulae, for Irrigation Engineers): Being a Series of Notes on Miscellaneous Subjects Connected with Irrigation—Compiled, with the Kind Help of Others, By Robert Burton Buckley, C.S.I., Chief Engineer India Irrigation Department (Retired), Member of the Institution of Civil Engineers, etc. Third Edition. New York: Spon & Chamberlain. London: E. & F. N. Spon, Ltd. Cloth; 5 x 7 in.; pp. 625; illustrated. $10.

The third edition of this beek has been enlarged by contributions from irrigation engineers in India and Egypt. The book is still, to quote from the Preface, "simply a compilation of facts, figures and formulas bearing on the everyday work of the Irrigation Engineer," which originated in a note-book kept "during 33 years work in India." A wide range of data on hydraulics and on the design, construction, cost and operation of irrigation works is given. Some of these data are as useful to other engineers as to those engaged in irrigation work. Naturally, many of the data are more applicable to India than to other countries but at the same time many are of world-wide applicability. There are numerous citations from American books and reports.

Water-Borne Typhoid in New York State

Most of *Health News* for October is filled with "A Review of Certain Water-Borne Typhoid Fever Outbreaks in New York State," by Theodore Horton, director, Division of Sanitary Engineering, State Department of Health, Albany, N. Y. One of the outbreaks reviewed, that at Schenectady, N. Y., early in 1920, is described at length by Mr. Horton in *Public Health Reports*, Oct. 29, 1920 (Washington, D. C.).

Sanitation Number

The "Typical Diseases Bulletin" (23 Endsleigh Gardens, London, N. W. 1, England; two shilling at issue) for Oct. 15, 1920, is a "Sanitation Number" containing abstracts of articles and reports falling under the general head, "Applied Hygiene in the Tropics," prepared by Lt.-Col. W. W. Clemesha.

PUBLICATIONS RECEIVED

THE AIRPLANE: A Practical Discussion of the Principles of Airplane Flight—By Frederick Bedell, Ph.D., Author of "Airplane Characteristics," "The Air Propeller," etc. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 257; illustrated. $3.

AMERICAN RURAL HIGHWAYS—By T. R. Agg, C.E., Professor of Highway Engineering, Iowa State College. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 139; illustrated. $2.

BUILDING OPERATIONS IN THE LARGER CITIES IN 1919—By Jefferson Middleton. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 18; illustrated.

Classified figures from 128 cities and more general statistics from 13 additional cities of 35,000 population with text summary. Shows numbers of permits and costs for new buildings and for alterations and repairs, grouped into wood and fire-resisting classes, the latter subdivided into brick or hollow tile, stone, concrete and steel skeleton.

CAST IRON FOR LOCOMOTIVE-CYLINDER PARTS—By C. H. Strand, Associate Physicist, Bureau of Standards. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 25; illustrated. Free upon request to the Bureau.

COLLISIONS, DERAILMENTS, AND OTHER ACCIDENTS RESULTING IN INJURY TO PERSONS, EQUIPMENT, OR ROADBED, ARISING FROM THE OPERATION OF STEAM ROADS USED IN INTERSTATE COMMERCE: Oct., Nov., Dec., 1919—Washington, D. C.: Bureau of Statistics. Paper; 9 x 12 in.; pp. 69. 10c. from Superintendent of Documents.

CONDENSED CATALOGUES OF MECHANICAL EQUIPMENT: Comprising Condensed, Uniformly Presented and Illustrated Catalogue Information Covering the Products of Manufacturers of Various Classes of Mechanical Equipment; with General Classified Directory and Consulting Engineers' Directory, Tenth Annual Vol., Oct., 1920—New York: The American Society of Mechanical Engineers. Cloth; 6 x 9 in.; pp. 1004; illustrated. $4. Issued free to every standing member of the Society of the year of publication. (Extra copies to members, $3.)

THE CONSTRUCTION OF ROADS AND PAVEMENTS—By T. R. Agg, C.E., Professor of Highway Engineering Iowa State College. Second Edition Revised and Enlarged. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 463; illustrated. $4.

Revised to include recent progress in highway engineering and changes in highway practice. Among the additions to the first edition are chapters on drainage and on the control of erosion and maintenance and a section on the proportioning of aggregates for concrete roads. The chapter upon testing highway materials has been rewritten. The first edition was reviewed in *Engineering Record*, Sept. 30, 1916, p. 418 and in *Engineering News*, Oct. 19, 1916, p. 745.

CONTRACTS, SPECIFICATIONS AND ENGINEERING RELATIONS—By Daniel W. Mead, Consulting Engineer, Professor of Hydraulic and Sanitary Engineering, University of Wisconsin, M. Am. Soc. C. E., M. A. S. M. E., etc.; with Chapter on Contracts by Frank Jenks, Member of the Wisconsin Bar. Second Edition. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 557; illustrated. $4.

The first edition was very favorably reviewed in these columns May 17, 1917, p. 364. In the present edition, the chapter on Contracts has been entirely rewritten and enlarged by Frank Jenks, of the Wisconsin Bar. The chapter on Success in the Engineering Profession now includes, in modified form, an inventory of personal characteristics as a basis for character study, originally prepared by Dean A. A. Potter of Purdue University; also a section on personal financial success and notes on the relations of engineering to business and finance.

DAILY RIVER STAGES AT RIVER GAGE STATIONS ON THE PRINCIPAL RIVERS OF THE UNITED STATES: Vol. XVII, 1919—By Alfred J. Henry, Meteorologist. Washington, D. C.: Weather Bureau. Paper; 9 x 12 in.; pp. 291.

DIE FLUSSMETALLE IM BRUCKENBAU: Insbesondere Ihre Einfuhrung—Von Dr.-Ing. E. J. Albrecht. Leipzig, Germany: Wilhelm Engelmann. Paper; 7 x 11 in.; pp. 56; illustrated. 12M.

A review of the introduction of steel in bridge construction, together with elementary comments on working stresses. A chapter on the use of high-strength steels has special interest through the favorable emphasis it lays on the prospects of high-carbon steel.

DORR SYSTEMS OF SEWAGE AND TRADE WASTE TREATMENT—By R. H. Eagles. Reprinted from the *Journal* of the Boston Society of Civil Engineers, Nov., 1920. New York: The Author, care of the Dorr Co., 101 Park Ave. Paper; 6 x 9 in.; pp. 268; illustrated.

EFFECTS OF CAL AS AN ACCELERATOR OF THE HARDENING OF PORTLAND CEMENT MIXTURES—By Roy N. Young, Associate Chemical Engineer, Bureau of Standards. Washington, D. C.: The Bureau. Paper; 7 x 10 in.; pp. 24; illustrated. 5c. from Superintendent of Documents.

ELASTIZITAT UND FESTIGKEIT: Die für die Technik wichtigsten Satze und deren erfahrungsmassige Grundlage—Von Dr.-Ing. C. Bach, Wurtt. Staatsrat, Professor des Maschinen-Ingenieurwesens, Vorstand des Ingenieur laboratoriums und der Materialprufungsanstalt an der Technischen Hochschule Stuttgart; Achte, vermehrte Auflage; Unter Mitwirkung von Professor R. Baumann, Stellvertreter des Vorstandes der Materialprüfungsanstalt an der Technischen Hochschule Stuttgart. Berlin, Germany: Julius Springer. Cloth; 6 x 9 in.; pp. 698; illustrated. 88M.

ELEMENTARY DYNAMICS: A Textbook for Engineers—By J. W. Landon, M. A., Fellow of Clare College, and University Lecturer in Mechanical Engineering, Cambridge. London: Cambridge University Press. Cloth; 5 x 7 in.; pp. 246; illustrated. 10½s.

ERTRAGREICHSTER AUSBAU VON WASSERKRAFTEN.—Von Dr.-Ing. Leiner, Beratender Regierungsbaumeister und Privatdozent an Der Technischen Hochschule Munchen. Berlin, Germany: Von R. Oldenbourg. Paper; 8 x 11 in.; pp. 111 illustrated.

Mathematical discussion of the efficient development of water powers.

FINANCIAL ENGINEERING: A Text for Consulting, Managing and Designing Engineers and for Students—By O. B. Goldman, Consulting Engineer, Professor of Heat Engineering, the Oregon State Agricultural College, etc. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 271; illustrated. $3.50.

THE FIREMAN'S HANDBOOK AND GUIDE TO FUEL ECONOMY: A Simple Manual for the Use of Stokers, Furnacemen, Foremen and Others operating and Controlling Boiler and Furnace Plant—By Chas. F. Wade, A.M.I.Mech.E., A.M.I.E.E., Technical Expert in Fuel Economy. New York and London: Longmans, Green & Co. Cardboard; 5 x 7 in.; pp. 84; illustraded. $1.

THE FLOW OF WATER IN CONCRETE PIPE—By Fred C. Scobey, Senior Irrigation Engineer; With Discussion by Kenneth Allen, Arthur S. Bent, F. C. Finkle, Allen Hazen, J. B. Lippincott, and H. D. Newell. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 100; illustrated 25c. from Superintendent of Documents.

Contains a general discussion of the subject; a review of formulas; a new formula by the author; summaries of 130 observations by the author on 30 separate conduits, of which 29 ranged from 8 to 63½ in. in diameter and one had a diameter of 120 in. and of other observations on conduits up to 18 ft. in diameter; discussions as noted in the sub-title; and three pages of conclusions. A valuable study and a worthy companion to the author's earlier bulletin (376) "The Flow of Water in Wood-Stave Pipe."

THE GREAT GAME OF BUSINESS: Its Rules, Its Fascination, Its Services and Rewards—By J. George Frederick, President of the Business Bourse, New York; Sales Engineer and Counselor; Treasurer and Governor for the New York Sales Managers' Club; Author of "Modern Salesmanagement," "Business Research and Statistics," etc. New York and London: D. Appleton & Co. Cloth; 5 x 8 in.; pp. 175. $1.50.

HANDBOOK OF BUILDING CONSTRUCTION: Data for Architects, Designing and Constructing Engineers, and Contractors. Vol. I and II—Compiled by a Staff of Forty-six Specialists; Editors-in-Chief, George A. Hool, S.B., Consulting Engineer, Madison, Wisconsin, Professor of Structural Engineering, The University of Wisconsin, and Nathan C. Johnson, M.M.E., Consulting Engineer, New York City. New York and London: McGraw-Hill Book Co., Inc. Flexible cover; 6 x 9 in.; pp. 1,474 in the two volumes; illustrated. $10 for both volumes (not sold separately).

THE HANDBOOK OF INDUSTRIAL OIL ENGINEERING: A Reference Book of Data, Relating to Lubrication and Industrial Oils, Including Tables, General Oil Information, etc.—By John Rome Battle, B.Sc. in M.E., M.E., Assoc. M. Am. Soc. M.E., M. Engrs.' Club of Philadelphia, Consulting Engineer. Philadelphia and London: J. B. Lippincott Co. Flexible cover; 5 x 8 in.; pp. 1,131; illustrated. $10 plus postage.

"The Lubricating Engineers' Handbook," which in revised form is included in this new work, was reviewed by Prof. John J. Flather in *Engineering News*, Feb. 15, 1917, p. 275. The scope of the enlarged volume is indicated by its subtitle, given above.

LABOR'S CRISIS: An Employer's View of Labor Problems—By Sigmund Mendelsohn. New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 171. $1.50.

LEHRBUCH DER EISEN- UND STAHLGIESSEREI: Verfasst Fur Den Gebrauch Beim Unterricht, Beim Selbststudium Und in Der Praxis—Von Bernhard Osann, Ordentl. Professor An Der Bergakademis in Clausthal, Geh. Bergrat. Ehrenmitglied Des Vereins Deutscher Giessereifachleute. Vierte, New Bearbeitete Und Erweiterte Auflag. Leipzig, Germany: Wilhelm Engelmann. Paper; 7 x 10 in.; pp. 672; illustrated. Paper: 42m. bound 54m.

THE PROBLEM OF HEALTHY TOWNS AND A HEALTHY INDUSTRIAL SYSTEM—By Captain J. W. Petavel, Lecturer on The Poverty Problem, Calcutta University. Reprinted from "The Englishman." Calcutta, India: Calcutta University Poverty Problem Study Fund. Paper; 6 x 8 in.; pp. 20.

PROPORTIONAL REPRESENTATION AND MUNICIPAL GOVERNMENT—By Charles A. Mullen. Reprinted from The Municipal World, May, 1920. Montreal, Can.: The Author, 84 Saint Antoine St. Paper; 5 x 8 in.; pp. 20. Single copies free from the author.

An exposition of proportional representation as a preventive of minority control of governments. The author is director of the Paving Department of the Milton Hersey Co., Ltd., Montreal and Winnipeg, Can.

PUBLIC SERVICE COMMISSION: Report, 1919, Second District. Albany, New York: The Commission. Cloth; 6 x 9 in.; pp. 820.

REPORT OF THE CHIEF OF THE CONSTRUCTION DIVISION OF THE SECRETARY OF WAR, 1920. Washington, D. C.: War Dept. Paper; 6 x 9 in.; pp. 83.

SAFETY IN THE MACHINE SHOP. Hartford, Conn.: The Travelers Insurance Co. Paper; 6 x 9 in.; pp. 188; illustrated Free on application.

An up-to-date exposition of the subject, written from the viewpoint of accident prevention.

SEWAGE DISPOSAL FOR RESIDENCES AND SMALL INSTITUTIONS—By R. B. Wiley. Lafayette, Ind.: Engineering Experiment Station of Purdue University. Paper; 6 x 9 in.; pp. 33; illustrated.

SILVANUS PHILLIPS THOMPSON (D.Sc., LL.D., F.R.S.) HIS LIFE AND LETTERS—By Jane Smeal Thompson and Helen G. Thompson, B.Sc. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 372; illustrated. $7.50.

UNION SCALE OF WAGES AND HOURS OF LABOR, MAY 15, 1919. Washington, D. C.: Bureau of Labor Statistics. Paper; 6 x 9 in.; pp. 281.

LETTERS TO THE EDITOR

The Dirty Automobile and the Quebec Bridge

Sir—In reading a recent issue of a motorist's paper I find they have discovered a new reason for the collapse of the Quebec bridge, which might be of interest to the profession. Under the caption "Keep the Car Clean," they say:

"It is a sound method of procedure never to allow dust or dirt to collect . . . If the owner will understand that one loose bolt, made so by grit and dirt, caused the collapse of the Quebec bridge, better attention will be given by him to the near-godliness of cleanliness."

Buffalo, Nov. 22. TOWNSEND CARPENTER.

Resistance of Aggregate in Galveston Fire

Sir—In the various interesting articles on the destruction of Pier 41 at Galveston which you have published one feature appears to have no consideration.

As is well known, lime rock calcines under high temperatures and to be strictly fireproof an aggregate that will withstand heat better than lime rock should, of course, be used. Gravels of igneous origin, sandstone, trap and other aggregates will undoubtedly withstand heat better. Some of the aggregate used in Pier 41 was limestone, some glacial gravel, and the observations reported in your journal would have considerably more value if the character of aggregate were named in the floors, beams and columns.

Wichita Falls, Tex., Dec. 4. HARRY PENNINGTON.

Canal-Seepage Water Transferred Through Under-Saturated Soil

Sir—The article describing the experiments of W. W. McLaughlin on "Capillary Siphoning of Water Through Soil," in your issue of Nov. 11, p. 933, recalls some studies which the writer made a few years ago.

A controversy arose between the owners of some 10,000 acres of waterlogged land and a ditch company whose canal was constructed on high ground on one side of the wet area, as to the relative responsibility of the canal company in waterlogging the area. The land owners maintained that the canal was one of the main contributors to the condition through its seepage water. The canal company took the position that the losses from their canal were insignificant, and to prove their point made an extended investigation. A series of vertical shafts, spaced about a mile apart, were sunk adjacent to the ditch and as near the edge of the water as safety would permit. The shafts were sunk to about twenty feet below the water line and tunnels were then driven under the ditch across its full width. No water was visible in any of the excavations although the material was moist. Actual seepage measurements on the canal indicated a considerable loss, but the engineers of the canal company concluded from their experiments that the proportion of their loss which reached the water table was negligible.

It was therefore up to the engineers for the wet land owners to prove that the seepage losses from the canal reached the water table even though the water had to travel through a column of soil which was not saturated. As a matter of fact the water did travel downward as capillary water in much the same manner as described by Mr. McLaughlin, but in this case the action was not strictly siphonic, since no impervious layers of soil intervened between the water table and the canal.

The controversy was aired in court before a jury. Lacking a systematic soil-moisture determination it became necessary to make an ocular demonstration of the phenomena before the jury in order to convince them of its truth. To do this a pan of water was set on the table and one end of a dish towel inserted in the pan, the other end being allowed to hang over the edge and reach almost to the floor. The experiment was started before court adjourned one evening and the next morning the pan was empty and the water on the floor. The towel, however, was saturated only at both ends, and was just moist in the middle. The jury was evidently convinced, for the "wets" won their point.

There is no reason why a column of soil should not have the same capillary characteristics as a piece of cloth, the rate of movement of course varying with the texture.

Boise, Idaho, Nov. 18. W. G. SLOAN,
Hays, Sloan & Lewis, Inc., Engineers.

Brick-Wall Demolition

Sir—In looking over the *Engineering News-Record* of Dec. 2, p. 1106, I noticed the article: "Brick Wall Torn Down With Dynamite," in which I was interested, as I have been handling explosives for many years, using them in blasting in quarries, wells, ditches and in removing old engine beds out of factory plants. I also recently shot down a brick wall. The brick wall was 125 ft. long, 40 ft. high and placed on a stone foundation. The thickness of the wall, which was laid up in cement mortar was 22 in. at the base. Holes were cut into the brick just above the stone foundation on 5-ft. centers. We placed 1 lb. of dynamite in each hole and exploded the charges with an electric blasting machine. The wall fell as a unit and covered the ground like a carpet, breaking all to pieces after striking. I find that in blasting walls of this nature, that the charges usually are too far apart and too heavy, as a result of which holes are blown in the wall, making it very dangerous to work with.

My practice, therefore, is: Place the charges close together, and use a light charge. Then you can always be pretty sure of your result. WILLIAM D. MEYER.

Quincy, Ill., Dec. 7.

The Dangerous Emergency Intake

Sir—*Engineering News-Record* of Dec. 2, p. 1101, notes an outbreak of typhoid at Schenectady, N. Y., which was due to pollution of the well water supplying the city by admission of raw river water through an old suction pipe extending into the Mohawk River and left in place "for use in case of emergency."

Is it not time for water-works engineers to desist from retaining abandoned intakes for "use in emergency"? Surely instances in plenty exist showing the unwisdom of such a practice. The experience of Butler, Pa., was convincing enough and followed the opening of an abandoned intake during repair work on the filter plant. A few years later the City of Erie in the same State suffered from a severe typhoid outbreak due to practically the same cause, although in the Erie case the former intake gate was not actually opened. Upon walking up to the head of the old inlet tunnel which ended on the wharf line the gate was found closed but a flow amounting to about one thousand gallons per day of exceedingly foul water was seen trickling through the surrounding masonry and passing thence to the pump well. About eight hundred cases of typhoid resulted. Orders were at once issued to stone up the tunnel—orders which should have been give years before when the old intake was abandoned "except for emergency reserve."

Troy, N. Y., Dec. 9. WILLIAM P. MASON.

Center Form for Wide Concrete Road

In the recent construction of a 30-ft. concrete road in Wayne County, Mich., a new method of striking the concrete surface was used. Instead of having a strike-board the entire width of the concrete the board was made only 17 ft. in length. Forms made of 2 x 8-in. lumber were put in at the road center. Use of these made is possible to strike half of the road at a time. As soon as the strike-board work was completed the center form was removed, the space filled with mortar and the belt finishing continued across the entire width of the pavement. It is stated in the annual report of the Wayne County Road Commission, that this method allowed smoother construction with fewer men than could have been effected with a long strike board used according to the usual methods.

NEWS OF THE WEEK

New York, December 16, 1920

Hettrick, Head of "Code of Practice" Ring Indicted

Charged with a violation of the Donnelly anti-trust law, John T. Hettrick, New York attorney and head of the so-called "Code of Practice" ring, which is said to have been a clearing house for the activities of a building combine operating in New York City, has been indicted by the grand jury as a result of disclosures made before the Lockwood joint legislative committee on housing. He was arraigned Dec. 13 before Justice McAvoy, in the criminal branch of the Supreme Court and released under $100,000 bail.

The activities of the Lockwood Committee have thus far resulted in the indictment of fifty-five individuals, not including Hettrick. This number includes Robert P. Brindell, president of the Building Trades Council, who has been indicted on five counts; Peter Stadtmuller, Brindell's lieutenant; sixteen members of the Employing Metallic and Furring Lathers Association; thirty-one members of the New York Cut Stone Contractors' Association; John A. Philbrick, Joseph Penny and Wright D. Goss, indicted for failure to answer questions; George Backer, indicted for perjury, and William H. Chapman, of the plumbers' union, indicted on charges of extortion. Backer has been tried, the jury disagreeing. The committee has also succeeded in having dissolved the Masons' Supply Bureau of Brooklyn, and the New York Cut Stone Contractors' Association.

Better Distribution of Aliens Aim of New Bureau

Through the establishment of a new bureau at Ellis Island, New York, in charge of economic and linguistic experts, better distribution of aliens, particularly with a view to avoidance of their congestion in large centers of population, is to be sought. The census this year reveals a tendency of the general population to flock to cities, and the new bureau, through its co-operation with state authorities, hopes to gain a much better distribution of aliens through rural communities.

The new bureau is to be known as the Division of Immigration Distribution and its chief, according to Immigration Commissioner F. A. Wallis, will probably be P. A. Donohue, an economic expert from the U. S. Department of Labor. Mr. Donohue has been a member of several boards of inquiry at Ellis Island, and it is believed he will be well fitted for his new position through his war work for the Federal Employment Bureau.

Transportation Representatives Discuss Place of Motor Truck in Modern Transport

Store-Door Delivery, Terminal Work and Short-Haul, Are Topics at Federal Highway Council Committee Meetings

Representatives of transportation agencies and other bodies met with the three transportation committees of the Federal Highway Council Dec. 10 at the Hotel Commodore, New York City, to determine the place of the motor truck in a modern transportation system. The motor truck was considered from the point of view of an aid to the railroads in short-haul business, as a means of reducing terminal charges in handling less-than-carload merchandise freight through the use of unit containers, and as a farm-to-market transportation agency.

General discussions preceded and followed the breaking up of meeting into three committee sessions. The transportation committees of the Federal Highway Council are: Committee on relation of highways to railroads and waterways, W. J. L. Banham, chairman; committee on study of rural motor express, J. H. Collins, chairman; committee on highway transport functions of state highway departments, David Beecroft, chairman. Special consideration was given to such topics as store-door delivery, terminal work, short-haul, economic and business-like operation of rural express lines, transportation surveys, traffic control and snow removal.

Store-Door Delivery

A. E. Beck, traffic manager of the Merchants and Manufacturers' Association of Baltimore, recalled that store-door delivery service by a railway-operated trucking company was begun in Baltimore in 1867 by the Philadelphia, Baltimore & Washington Ry. (now part of the Pennsylvania system). Later the Baltimore & Ohio instituted a similar service. Both companies then began store-door delivery, also in Washington. After successful operation for 46 years the service was withdrawn because of actions before the Interstate Commerce Commission looking to extensions of the free-delivery zone beyond what the railroads considered reasonable. As a result of the dropping of the plan great congestion ensued at the terminals.

Mr. Beck advocated store-door delivery strongly, asserting that only through it could terminal congestion be avoided. He advocated that existing trucking companies be employed for this work, though the service should be included in the railroad rate. It should apply, he believed, only to l.c.l. freight, and a pick-up or collection system for outgoing freight should be worked in connection with the delivery plan.

A digest of the recommendation of the subcommittee on store-door delivery, adopted at the recent meeting in Akron, Ohio, was presented stating that municipal areas should be divided into zones and zone distribution designated on way bills. Colonel Charles D. Hine, special agent, Erie R.R. and New York, New Haven & Hartford R. R., who was previously vice-president of the Southern Pacific R.R. Co. of Mexico, pointed out that the fear of carriers having the additional cost of store-door deliv-

Chicago Railway Electrification Before Engineer Board

The Illinois Central R.R. has taken another step toward electrifying its Chicago terminal and suburban lines by the appointment of a board of engineers to consider the different systems and prepare general plans. It is expected that the report will be made in about six months. The board is composed of A. S. Baldwin, vice-president Illinois Central R.R.; D. J. Brumley, chief engineer Chicago terminals; Bion J. Arnold, consulting engineer; George Gibbs, consulting engineer; Cary T. Hutchinson, consulting engineer; W. M. Vandersluis, signal engineer. Under the ordinance of July 21, 1919, work must be commenced by 1922.

Cement Manufacturers and Dealers Lower Prices

In line with a sharp decrease in the price of cement in the Middle West, cement manufacturers supplying the New York district have dropped their price 20c. per barrel, while New York dealers on Dec. 6 cut their prices from $4.10 per barrel, delivered, exclusive of bags, to $3.80—a decline of 30c. per barrel. In Jersey City dealers who were receiving $3.55 net, delivered, are now asking $3.20.

In Chicago the dealers' net price has declined from $3.60 to $3. Minneapolis reports a drop of 50c.—from $3.50 to $3—and the city purchasing agent has advised that the city has been given a quotation of $2.76 per barrel on large orders.

ery harnessed onto them without additional compensation was a practical obstacle, but that the carrier should control transfer and storage. Colonel Hine said that carload store-door delivery was as important as l.c.l. delivery in releasing cars. W. C. Brinton, consulting engineer, New York City, pointed out the need for heavier capacity elevators in industrial and loft buildings to facilitate freight delivery and shipment from origin.

F. E. Williamson, general superintendent New York Central R.R. Lines East, said that terminal operation was the neck of the bottle in railroad transportation and anything that could be done to increase terminal capacity would increase line haul and would be welcomed by the railroads. A. E. Beck said that store-door delivery of carload freight in Baltimore was abandoned because it was found that manufacturers with sidings would use such delivery instead of a full use of existing sidings. When store-door delivery was furnished in Baltimore, embargoes were unknown.

F. S. Holbrook, vice-president and treasurer American Railway Express Co., New York City, believed that it was not feasible at present for express companies to handle store-door delivery because of the too great proportional increased cost and the probable difficulty with labor conditions. Mr. Lincoln, traffic manager Merchants' Association, New York City, said that the freight situation in New York City could never be satisfactorily relieved without store-door delivery, but that laws would have to be revised so as not to require 48-hr. arrival notices. Such delivery at New York would have to provide for carload shipments.

Resolution

Following the discussion on store-door delivery a resolution was passed instructing the committee on store-door delivery to consult with certain carriers and shippers with a view to the establishment of the store-door delivery plan, and to report at the next transportation conference of the council upon a concrete plan.

Cincinnati Terminal

B. F. Fitch, president Motor Terminals Co., New York and Cleveland, who developed the system of operation for transferring less-than-carload freight between main and sub-stations in the city of Cincinnati in demountable truck bodies, described the method of operation in that city and outlined the results obtained. Fifteen motor-truck chassis have handled about 28 per cent of all less-than-carload business in Cincinnati on six railroads, as indicated by the actual figures of one. Mr. Fitch presented a report from one of the railroads in Cincinnati indicating that loss and damage claims on such l.c.l. freight had been reduced about 50 per cent since the motor transfer service had become fully effective. The transfer company has not sustained a single claim for loss and damage in handling 200,000 tons of freight.

Mr. Fitch outlined the further general application of motor transfer service for railroad transportation and in the case of New York City he pointed out that it would be possible to increase the carrying capacity of Manhattan city streets 1,500 per cent before present congestion would be reached.

Terminal Costs High

C. W. Reid, manager transportation bureau, Federal Highway Council, presented figures from the Interstate Commerce Commission reports and other data indicating that total terminal l.c.l. cost in the eastern district averaged about $2 per ton. He said that the Federal Highway Council could take no better position than to urge that the railroads undertake a study of short-haul conditions involving such l.c.l. movement. The total terminal cost of handling such freight including delivery to store door of miscellaneous shipments would probably amount to $12 per ton, or 60c. per 100 lb. Colonel Hine stated that these figures were probably high and that the best results could be obtained not by taking short-haul business away from railways but by enabling them to carry out broader transportation functions by the operation of motor trucks and other equipment. W. J. L. Banham proposed a resolution which was adopted providing for enlargement of the committee to include additional representatives of trucking, shipper and railroad interests.

The committee on the study of rural motor express enlarged upon the material which it is to include in its publication, which will contain facts and figures as to the economic management of rural express lines. This committee hopes to establish a status for the rural motor express, to eliminate the fly-by-night concerns, and through its publication, offer sound policies for rural express lines to adopt.

Need for Transport Engineers

That the state highway departments need the services of a new official in the form of a "highway transport engineer," was the opinion expressed by W. G. Thompson, H. G. Shirley and others at the meeting of the committee on highway transport functions, of which David Beecroft is chairman. It was pointed out by Mr. Thompson that the traffic surveys, as ordinarily made, form no basis for pavement design. A campaign of propaganda designed to educate members of commissions and the general public to the necessity for highway transport engineers is required. Recognizing the shortcomings of the traffic census, as now taken, Mr. Shirley advocated a new kind of census, involving a house-to-house canvass of producing and consuming units.

To Prof. Arthur H. Blanchard, professor of highway engineering at the University of Michigan, was intrusted the duty of preparing a report defining the functions of a highway transport engineer. With this material in hand it is proposed to enlist the co-operation of civic organizations, such as chambers of commerce, toward securing the necessary legislative authority for the appointment of these officers in various states.

The outcome of the discussion on the subject of snow removal was the approval of a recommendation to the effect that a communication should be sent to the American Association of State Highway Officials suggesting to that body that state laws be amended so that snow removal shall be considered as a part of maintenance, thereby opening up the way for the use of highway maintenance funds for snow-removal work.

Shut-Down Threatened on Skagit Power Project

Work on the Skagit River hydro-electric power project, under development by the city of Seattle, is threatened with indefinite suspension on account of the inability of the city to dispose of its bond issue voted for the project. Work has been reduced 75 per cent and may be forced to close down next month unless money is obtained by the city to continue its operations. More money has been spent than has been realized on the sale of utility bonds. Several millions in bonds remain available, but are useless until sold as conditions in the bond market make 6 per cent utility bonds somewhat unattractive.

According to a statement submitted by City Comptroller Harry W. Carroll the deficit amounts to $45,756.55. Thus far $1,698,769.01 has been expended. It is estimated that an expense of $100,000 would be entailed by suspension of operations and later reassembling of crews.

Engineer C. F. Uhden, in charge of the project, states that he will continue operations, although confining them to the tunnel being bored for the Newhalem power site, which is only preliminary to the Gorge development, the first unit in the Skagit project, so far as delivery of power to Seattle is concerned. Mr. Uhden states that if he is able to proceed without his forces being crippled current will be delivered in Seattle in 1923 at a cost estimated at 4¾ mills per kilowatt-hour, or less than half a cent.

Bonds totaling $5,500,000 have been voted for the Skagit work. Informal negotiations with bond houses for their sale have been undertaken. The bond issue voted will not be enough to cover the project as contemplated, City Engineer Dimock stating that the soundest development plans involve an expenditure of $9,000,000, such construction developing 34,500 kw. This sum would install wheels capable of generating 54,000 kw. by the construction of a great dam costing several more millions, and further development of the Gorge Creek unit.

Pennsylvania Contractors Effect Permanent Organization

Permanent organization of Pennsylvania highway contractors was effected at Harrisburg recently, the new body to be known as the Associated Pennsylvania Highway Contractors. The following officers were elected:

President, Henry H. Wilson, Winston & Co., Hughesville; 1st vice-president, Benjamin Harrison, Harrison & Co., Derry; regional vice-presidents, W. J. Wiseman, Booth & Flinn, Pittsburgh; R. S. Rathbun, Rathbun Contracting Co., Bethlehem; H. S. Souder, Souder Construction Co., Lancaster; William Horn, Horn and Devling, Galeton; treasurer, Samuel M. Irwin, Union Paving Co., Philadelphia. The board of governors will be composed of the president (ex-officio); Aldrich Durant, MacArthur Bros. Co., New York; William D. Hill, Samuel Gamble Co., Carnegie, Pa.; Samuel M. Irwin, Union Paving Co., Philadelphia; William McCrady, McCrady Bros. Co., Pittsburgh.

E. J. Harding, assistant secretary of the Associated General Contractors of America, has been loaned by that association to perfect all details of organization and act temporarily as secretary and general manager of the new association.

Steel-Wood Stave Pipe Controversy in Seattle

A strong effort is being made by the Chamber of Commerce, Seattle, through its Pacific Northwest Products Committee, to force the city to spend the greater part of the proposed $3,000,000 extensions to the city's water system in Seattle in the purchase of wood stave pipe instead of steel pipe as proposed. The contract to be let for steel or wood pipe is for the No. 3 pipe line, to bring in water to the municipal reservoir. Representatives of Seattle industries point out that if steel pipe is purchased practically all of the $3,000,000 will be sent to eastern points while wood stave pipe may be purchased from a Seattle manufacturer. An early conference will be held by Mayor Caldwell, A. H. Dimock, city engineer, and representatives of the committee to discuss the question. L. B. Youngs, superintendent of water, is said to favor steel pipe.

Let Contract for New Savannah Coaling Terminal

Contracts were recently awarded by the Savannah Coal & Dock Co., Inc., a subsidiary of the New York Tidewater Coal Co., to the A. Bentley & Sons Co., Toledo, Ohio, for the development of a coaling station on the Savannah River, Savannah, Ga., at an amount approximating $5,000,000. The work includes the dredging of a ship canal, 1,000,000 cu.yd., and a railroad transfer station covering 500 acres. Charles P. Lyman, New York City, is president of the company, and Charles H. Preston, corporation engineer, Waterbury, Conn., has been retained as consulting engineer.

Work Started on New Hudson River Power Development

Construction has just been begun on a 30,000-kw. hydro-electric plant on the Hudson River, about 5 mi. west of Glens Falls, N. Y., for the International Paper Co. A head of 70 ft. will be developed by a hollow reinforced-concrete dam located 800 ft. above Sherman Island; the present north branch of the river will be utilized for a tail-race. The contract for the work was given to the Parklap Construction Corp., an organization auxiliary to the firm of Parsons, Klapp, Brinckerhoff & Douglas, consulting engineers, New York City. W. J. Douglas, president of the corporation, is in general direction of the work, and E. A. Little, works manager, has field charge.

Sanitary Engineers Hold Conference on Malaria Control

A conference of sanitary engineers engaged in malaria control work was held at Louisvill, Ky., Nov. 16 and 17. The purpose of the conference was to discuss methods of malaria control, particularly in regard to experiences in anti-malaria campaigns conducted during the past year by co-operation of the U. S. Public Health Service and the International Health Board with state boards of eleven southern states.

Among the papers read were: "Organization of Malaria Control Division in State Boards of Health," L. M. Fisher, associate sanitary engineer, U. S. P. H. S.; "County Mosquito Extermination Organization," Wm. H. De Mott, chief engineer, Nassau County, N. Y.; "Railroad Malaria Work" M. W. Van Hovenberg, sanitary engineer, St. Louis Southwestern R.R.; "The Relation of Agricultural Drainage to Malarial Control," S. H. McCrory, engineer-in-charge, Agricultural Engineering, U. S. Department of Agriculture; "Sub-Soil Drainage," J. G. Foster, assistant sanitary engineer, U. S. P. H. S. Other subjects discussed included: methods of promoting and financing anti-malaria campaigns; publicity; malaria statistics; relation with outside engineering departments; use of fish, oil burners and weed-killing larvacides in mosquito eradication; foreman and labor problems.

On Nov. 15, the sanitary engineers met with the National Malaria Committee, a section of the Southern Medical Association, in session at that time. At this meeting a paper on "Co-operative Anti-Malaria Campaigns in the United States in 1920" was read by J. A. LePrince, senior sanitary engineer, U. S. P. H. S. Mr. LePrince was with General Gorgas in direct charge of the yellow fever and malaria control work in Panama from 1904 to 1914.

A joint meeting was held with the Engineers and Architects' Club of Louisville on the evening of Nov. 16. A paper, "Engineers and Malaria Control," was read by W. G. Stromquist, sanitary engineer, City Health Department, Memphis, Tennessee.

Government Studying Columbia Basin Project

Three engineers appointed by the U. S. Reclamation Service are now making an investigation of the Columbia Basin Irrigation project noted in *Engineering News-Record*, Nov. 11, 1920, p. 944. They are D. C. Henny, James Munn and C. T. Pease. It is expected that they will soon present a report on the general features of the scheme, which will be used as a basis for any Governmental connection with the work.

Large Majority for Kansas Good Roads Amendment

Out of a total vote of 478,036 the Kansas good roads amendment, the passage of which was noted in *Engineering News-Record*, Nov. 11, p. 960, received a favorable majority of 91,342 votes. Of 105 counties in the state 72 were favorable to the amendment, 32 unfavorable and in one county the vote was a tie.

Proposal to Transfer Patent Office and Weather Bureau

The McCormick bill to establish a department of public works and public welfare, noted in this journal Dec. 2, p. 1107, also provides for transfers to the existing Department of Commerce as follows:

(a) From Department of Agriculture—Weather Bureau.
(b) From Department of Interior—Patent Office.
(c) From Department of the Treasury—Coast Guard.
(d) From Department of War—Lake Survey Office, Inland and Coastwise Waterways Service.
(e) From Department of the Navy—Hydrographic Office, Naval Observatory.
(f) Commission for Standardization of Screw Threads—(Abolished and its Functions transferred to Bureau of Standards).

Sacramento Goes From Commission to Council-Manager Plan

By a vote of 7,692 to 1,587 out of a registration of 30,469 Sacramento, Cal., voted on Nov. 30 to change from the commission to the council-manager plan of city government and to elect the nine members of the Council by the proportional representation system. The first election under the new plan will be held on May 3, 1921, when a full new Council will be chosen. Within five days after the election the Council must organize, but for the sole purpose of choosing a city manager—to the end that, if possible, the manager may take office on June 30, when the new charter goes into full effect. The city manager will appoint all executive officers except himself, the city attorney, city treasurer, city clerk and police judge. The city engineer will exercise many of the present functions of commissioners of streets and of public works. The present board of parks and playgrounds will be succeeded by superintendents of parks and playgrounds. The Board of Education will be appointed by the City Council and will have as its executive officer a superintendent of schools. The population of Sacramento by the 1920 census was 65,857.

Washington Needs $6,000,000 for 1921 Road Work

State Highway Commissioner James Allen, Olympia, Wash., announces that between $6,000,000 and $7,000,000 will be necessary to complete the road building projected in the State of Washington during 1921. In all, 112 miles of state highways have been hardsurfaced during the past two years representing virtually the whole program outline. No new work will be started until after the legislature decides how much money is to be made available.

May Rebuild Gulf Coast Bridges

At hearings held in New Orleans during the past week the Louisiana Railroad Commission inquired into the question whether bridges and trestles of the Louisville & Nashville R.R. Co. over Chef Menteur and the Rigolets, between New Orleans and Mobile, are unsafe and should be replaced with new structures. In the testimony at the hearings it was shown by the railroad company that the bridges had given satisfaction and were equal to all requirements except hurricanes and tidal waves such as that of 1915, when it would have been perilous for railroad trains to attempt to cross the bridges in any event. However, in view of the severity of storm effects in the exposed locations of the bridges under extraordinary weather conditions the railroad company decided three years ago either to change the line of the road by an inland diversion, or to reconstruct its bridges and change the type of construction employed.

After detailed surveys for inland routes, it is said, the company discovered that the present constitution of the State of Mississippi prohibits changes in the main line of railroads traversing the state, and therefore has concluded that rebuilding the structures on their present locations is necessary. Plans have been drawn for steel bridges resting on concrete piers in place of the trestle supports heretofore used. The proposed work was stopped by the government taking over the railroads, and since their return, according to W. L. Mapother, executive vice-president of the Louisville & Nashville, financial conditions and high prices have interfered with execution of the project.

Plans for the proposed structure have been filed with the Railroad Commission by W. H. Courtenay, chief engineer of the railroad. The estimated costs are $1,334,000 and $3,422,000. A contract for the construction has been made with the American Bridge Co., to be carried out as soon as the financial condition of the company will warrant the expenditure. It is said to be not unlikely, however, that the railroad company will be asked to hasten the work of constructing new bridges in order that the present timber construction may as soon as possible be replaced by concrete substructure and steel superstructure.

Federal Power Commission Needs $482,000

Estimates of the Federal Power Commission submitted to Congress Dec. 6 indicate that an appropriation aggregating $482,065 is required, $100,000 to be used to reimburse executive departments for investigations requested by the commission. General expenses for authorized work of the commission, exclusive of personnel, are fixed at $137,000 and the estimate covering salaries is $240,000. All of these estimates, according to Engineering Council, appear to be the lowest amounts consistent with effective operation of the commission under the requirements of the law. Since this item will effect practically every phase of the engineering field it is appropriate, Engineering Council believes, that engineers and engineering organizations as such should use their efforts to obtain this appropriation by advising their representatives in Congress of the engineering and commercial value that power development, properly administered, will be to the country.

Defer Grand Trunk Arbitration

At the meeting of the Board of Arbitration on the Grand Trunk Ry. settlement, Nov. 5, it was decided to allow representatives of the stockholders such time as might be needed to prepare the case. Feb. 1, 1921, was set for the formal opening of the arbitration proceedings, which will take place at Montreal. The principal point at issue is to fix the value of the Grand Trunk stock in transferring the property to the control of the Canadian Government.

Small Referendum Majority Against Portland Zoning

The zoning ordinance for Portland, Ore., passed by the City Council last March (see *Engineering News-Record*, May 6, 1920, p. 899) but through petition of opponents sent to referendum, was defeated by a vote of 30,651 to 30,150 on Nov. 2. The measure had to compete for attention with 92 candidates for office, 11 state measures and 6 city charter amendments. Petitions have been filed with the City Planning Commission asking that the 149 precincts (about half the area of the city, mostly residential) that voted for zoning should be allowed to come under the ordinance. The proposal is being given consideration. Meanwhile the city has the advantage of a building code provision requiring a special hearing before the City Council on application for a permit for a new apartment, industrial building, garage and buildings for some thirty other kinds of business, the hearing to be preceded by a notification to all owners of buildings within 200 ft. of the proposed building. It is stated that the Portland ordinance in question is the first zoning ordinance that was ever submitted to popular vote in this country.

George S. Rice, Rapid Transit Engineer, Dies

George S. Rice, whose death on Dec. 7 was announced in these pages last week, was widely known for his prominent connection with rapid transit subway development in Boston and New York and for his work on the Croton Aqueduct for supplying water to New York City. He had been division engineer of the Transit Construction Commission in charge of subway construction in Brooklyn and continued work to within a few weeks of death.

Born in Boston, Feb. 28, 1849, Mr. Rice was graduated from the engineering school at Harvard University in 1870. During his later days in college he obtained work in the engineering department of the Boston water works and on graduation became assistant to the chief engineer. In that capacity he had charge of the construction of several miles of tunnel running to the Chestnut Hill reservoir.

From 1880 to 1887 Mr. Rice engaged in mining engineering in Colorado and Arizona. He later returned to New York and became deputy chief engineer of the Aqueduct Commission, in which capacity he remained until 1891, when he went to Boston to act as chief engineer of the Rapid Transit Commission of that city. From 1892 to 1900 he was an instructor in sanitary engineering at Harvard University, during which time he made studies for the first subway in New York. In 1900 he was appointed deputy chief engineer of the Rapid Transit Commission of New York and when William Barclay Parsons resigned as chief engineer in 1904 Mr. Rice was appointed to the position. When the Rapid Transit Commission was absorbed by the Public Service Commission Mr. Rice continued as construction engineer, and, later, in the capacity of division engineer for the Brooklyn subways.

Shortage of Railroad Facilities Shown in I. C. C. Report

Emphasis is laid on the general shortage of transportation facilities in the annual report of the Interstate Commerce Commission to Congress, transmitted Dec. 9, 1920. "As a result of the inadequacy of the car supply and of railroad transportation facilities generally during the past year," says the report, "a practice has grown up among shippers of bribing operating employees." However, despite the shortage of equipment, it is shown that the volume of freight carried during the first seven months of 1920 exceeded the freight carried during the corresponding period of 1919 by 17.1 per cent, as a result of more intensive operation.

The report also says that the immediate payment to the railroads of sums due them under the guarantee provisions of the Transportation Act, but withheld by the U. S. Treasury on a legal technicality, is "vital . . . in order that the carriers may properly

serve the public," and suggests amendment of the law to permit payment.

Other amendments suggested cover the transportation of explosives, the use of wooden passenger cars, and penalties for accepting bribes for preferred car service.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City, Jan. 19-20, 1921.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; New Orleans, Jan. 25-27.

ENGINEERING INSTITUTE OF CANADA, Montreal; Toronto, Feb. 1-3.

The Engineering Institute of Canada will hold its thirty-fifth annual general and professional meeting at the King Edward Hotel, Toronto, Feb. 1-3. The program for Feb. 1 includes registration at King Edward Hotel, address of welcome, annual business meeting, reports of scrutineers, address of retiring president, inauguration of incoming president, reception, smoker. Feb. 2: Professional meeting, new business and general discussion, annual banquet of the Institute at King Edward Hotel. Feb. 3: Excursions, continuation and closing of profssional meeting, dance at Hart House to be given jointly by the Engineering Society, University of Toronto and the Institute.

The Vancouver Branch, British Columbia Technical Association, held its second smoker in the Old Colony Tea Rooms, Dec. 2.

The Engineers' Club of Philadelphia, will hold a meeting Dec. 21; the subject will be "Road Construction for Heavy Truck Traffic."

The Rochester Engineering Society, at its noonday luncheon, Dec. 7, was addressed by Edward D. Seymour, chief plant engineer, Vacuum Oil Co., who has recently returned from a seven months' trip in Italy, France, Portugal and England.

The Iowa Engineering Society will hold its annual meeting Jan. 18-20, 1921, at Des Moines. Under the new plan of consolidation prepared at the last annual meeting, six local engineering organizations have become district clubs of the State society.

The Engineers' Club of San Francisco, at its noon-day meeting Dec. 1, was addressed by J. Waldo Smith, chief engineer, board of water supply, New York City, on New York's water supply problems. Mr. Smith was introduced by M. M. O'Shaughnessy, city engineer of San Francisco who announced that Mr. Smith was in San Francisco at the invitation of the Chamber of Commerce to advise in regard to the future water supply of San Francisco.

The Seattle Branch, Am. Soc. E. C., is considering the establishment of a student section at the University of Washington.

The Engineers' Club of Seattle, at a recent special meeting, was addressed by C. F. Uhden, chief engineer, Skagit River power project, on "Skagit River Development."

The Western Society of Engineers, at its meeting Dec. 7, was addressed by three speakers on "The Commercial Use of the Airplane." John F. Hayford discussed research problems; A. R. Rhenisch, recent progress and costs; Walter Painter, commercial airplane types. The following meetings are announced: Dec. 17, three speakers will present papers on "Recent Tendencies in Electric Railway Development"; Dec. 18, the Young Men's Forum is sponsor for a talk by O. M. Fox of the Business News Department of *Engineering News-Record* on "Economics and the Engineer"; Dec. 20, "Investigation of the Water Supply of Small Cities," by William Artingstall.

PERSONAL NOTES

J. K. SIMMS, formerly with the St. Louis-San Francisco Ry. on railroad location work, has accepted a position on the engineering staff of the Tela Railroad Co., Tela, Honduras, C. A. The Tela Railroad is controlled by the United Fruit Co., which is developing the banana industry of Honduras.

WALTER E. SPEAR, formerly department engineer of the New York Board of Water Supply, has returned to New York from Greece where he conducted for a period of eight months an investigation for Ford, Bacon & Davis, consulting engineers, New York, of the projects for water supply and sewerage systems for Athens and Piraeus.

PROF. C.-E. A. WINSLOW of the Yale University School of Medicine, has been granted leave of absence for the spring term in order that he may assume the directorship of the public health activities of the League of Red Cross Societies at Geneva. Prof. Winslow will return to New Haven for the opening of the fall term, Oct. 1, 1921.

A. W. K. BILLINGS, consulting engineer, Barcelona, Spain, is in the United States for a brief visit and may be addressed at the Engineers' Club, New York City. Since 1912 he has been connected with the Ebro Co., filling successively the position of manager of construction, managing director, vice-president and consulting engineer. During the World War he was in charge of naval aviation construction in Europe, and was promoted to the rank of commander and awarded the Legion of Honor and the Navy Cross for distinguished service in this work.

T. J. STRICKLER, chief engineer, Kansas Public Utilities Commission, Topeka, Kan., has resigned to become engineer for the Empire Gas & Fuel Co., Bartlesville, Okla.

ARTHUR H. BLANCHARD, professor of highway engineering, University of Michigan, has been engaged as consulting engineer for paving work to be done in Colorado Springs, Col., next year at a cost of about $1,000,000.

RICHARD S. HOLMGREN, formerly with H. K. Barrows, consulting engineer, Boston, is now assistant engineer with L. H. Shattuck, Inc., engineers and contractors, Manchester, N. H., who are making investigations of the sewerage system of Manchester.

N. D. DOANE, formerly experimental engineer with the Goodyear Tire & Rubber Co. of Akron, Ohio, is now engaged in sanitary work for Charles H. Hurd, consulting engineer, Indianapolis, Ind.

H. McL. HARDING, consulting engineer of New York, has been retained by the city of New Haven, Conn., as consulting engineer on its port development.

C. F. GRAESER, formerly resident engineer on design and construction of municipal improvement work with W. B. Saunders, consulting engineer, Helena, Mont., has accepted a position as assistant engineer, Minnesota Highway Department.

ROBERT K. WILLIAMS has been engaged as Southern representative of F. L. Grant, Inc., engineers and contractors, Clarksburg, W. Va.

FREDERICK C. HITCHCOCK has resigned as vice-president and general manager of MacArthur Brothers Co., contractors, New York, with whom he has been associated many years, to become president of Carey, Campbell & Co., contractors, with offices in New York and Erie, Pa. Mr. Hitchcock is also vice-president of the Siems-Carey Railway & Canal Co., which holds concessions for railway and canal work in China.

HENRY S. COWELL, formerly with the American International Shipbuilding Co., Hog Island, Pa., as structural designer and for the past year with the Southern Engineering Co., Charlotte, N. C., is now designing engineer on plant construction with the Champion Fibre Co., Canton, N. C.

HIRAM D. PHILLIPS, assistant division engineer, Massachusetts State Department of Public Works, Bureau of Highways, has been appointed engineer of District No. 2, Franklin and Hampshire Counties, Conn., to succeed C. H. Howes, resigned.